CONSERVATION OF LIBRARY MATERIALS

A SEMINAR, 1985

Editor :
KALPANA DASGUPTA

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FOREWORD

I take great pleasure in writing this unnecessary foreword. The National Library is pursuing its plans to hold Conferences on topics of common concern for librarians and academics occasionally as they become feasible. The first choice went appropriately to the importance of preservation. The Library has since followed it up with a Conference on Bibliographic Control and one on Indology. What you have now before you is the proceedings of the Conference on the Conservation of Library Materials held in 1985. My colleagues in the Preservation Division of the National Library celebrated 25 years of the existence of that Division in 1983 and the topic of a Conference of this kind was mooted on that occasion. They are, of course, perfectly competent to organise and present the proceedings of such a meeting and my role is only to draw attention to the continuing policy of the National Library to hold such Conferences in important areas of concern in order to gather together specialists of India and, whenever possible, those working abroad. I am pleased to say that the proceedings of the other two Conferences I mention are also now in press.

I should now like to perform a necessary task with gratitude I am indebted to all my colleagues who worked for the seminar and contributed towards the making of this book. In particular my colleagues in the Preservation Division, who have worked spontaneously and whole-heartedly to make the seminar a success, deserve all praise. Colleagues in the Bibliography Division, specially Smt. Arati Banerjee, Assistant Librarian, and Smt. Arati Chatterjee, Technical Assistant, deserve commendation for their efficient and painstaking work in the compilation of the select bibliography. The zeal and the application of Sarvashri Avinashi Lal, Deputy Librarian, and Amal Chandra Das, Assistant Librarian who arranged the seminar from its very inception and have made this publication possible, merit our special thanks. My thanks are also due to Shri Himangsu Guha who prepared typed copies of the entire seminar material. The Librarian, Smt. Kalpana Dasgupta, who has edited the collection and written its introduction requires no special thank from me. I would like, however, to mention from both of us how grateful we are to Shri A. K. Ghatak, Manager, Government of India Press, Santragachi, and his staff, without whose sincere help and co-operation the publication of this book would not have been possible.

ASHIN DAS GUPTA
Director

INTRODUCTION

This publication is a compilation of papers relating to the seminar on "Conservation of Library Materials" held at the National Library on 21st and 22nd January, 1985. It is note-worthy that this seminar was a joint endeavour of librarians, conservationists, planners and administrators. Each article focuses specific areas of problems and solutions which taken together represent the total spectrum of conservation activities of the library.

The publication basically consists of 4 inter-related component topics, *i.e.*, (i) Conservation & library conservation in general, (ii) Technical aspects relating to library conservation, (iii) Proceedings, Recommendations, etc. of the Seminar and (iv) A bibliography on conservation of library and allied materials.

Under the first category of articles one finds the first article entitled "Library Conservation and the Laws of Library Science" by Shri P. B. Roy. He pin-points and high lights conservation as an integral part of all the 5 laws of Library Science as propounded by Dr. S. R. Ranganathan. He advocates cooperative endeavour to battle this formidable problem with suggestions to create wider social awareness to achieve the desired goal. The second article entitled "Conservation Studies & Problems in Developing Countries with Special Reference to India" contributed by Shri Ranbir Kishore, one of the national experts on archival & library conservation, deals with the basic considerations of library conservation in the third world countries in general and in India in particular where constraints of resources are acute. He identifies three basic steps such as (i) scientific storage & environment, (ii) effective & compulsory deacidification of library materials followed by (iii) reinforcement of fragile materials with suitable protective sheets. He also suggests indigenous and less expensive remedial measures for under developed countries. The third article entitled "Importance of Conservation of manuscripts and Printed Materials" contributed by Shri H. R. Sood emphasizes the importance and urgency of proper scientific conservation of library materials.

The article "Conservation Movement in India" by the leading national conservationist Shri O. P. Agarwal projects a birds-eye view of the genesis and evolution of activities connected with conservation of cultural property in India. It is interesting to note that the genesis and infancy of conservation activities started in Calcutta which after successive stages have now assumed the present polycentric form as National Museum Laboratory, New Delhi, for conservation of Museum objects, National Archives of India, New Delhi, and National Library, Calcutta as premier institutions for conservation of archival and library materials.

Conservation of library materials combines the art of appreciation of aesthetics in library materials and the science of complex conservation techniques. Since the concept of these techniques is also changing fast with the advancement of science and technology, the prospective conservation workers require training and education in the latest scientific methods of conservation. The importance of such training has been highlighted in the article "Education in Library Conservation in India" by the noted library professional, Dr. Aditya Ohdedar. The article outlines the history of library conservation training facilities in India and suggests future development. The author proposes a curriculum for library conservation training course both theoretical and practical, in his paper.

The last article in this section is "Evolution of Conservation Activities of the National Library, Calcutta" by Shri A. C. Das, Assistant Librarian in the National Library, Calcutta. The article traces the origin and development of preservation activities in the National Library against the background of the growth of the National Library itself. The article relates many interesting and historical events which eventually led to the formation of the present "Conservation Wing" of this Library consisting of three major technical divisions manned by skilled workers and trained officers. It also projects the interesting and pioneering conservation activities of the great Librarian-Conservator of the Imperial Library, Late Mr. J. A. Chapman (1911-30) and the colossal task accomplished by Shri B. S. Kesavan, the first National Librarian to bring into existence the present conservation wing of the National Library, Calcutta.

The second series comprises of the actual technical papers relating to different hazards of preserving library materials, the causes for their decay and damage and the methods of actual treatment.

The foremost article in this series entitled "Modern Book—A Problem to the Librarian" presented by Shri Avinashi Lal, Deputy Librarian and Head of the Conservation Wing of the National Library brings to the forefront the basic problems of modern book conservation. According to him, the life of a book essentially depends on quality of paper. He points out that the paper used for printing books are substandard in quality which needs to be deacidified before restoration. He opines that publishers should be encouraged to publish special library copies of important publications on 'permanent paper', which eventually will reduce the cost of future conservation.

In the second article "Conservation & Repair of Paper Based Materials" Shri Y. P. Kathpalia, a national expert on archival and library conservation, enumerates the various enemies of books, suggesting the specific preventive and curative treatments along with their actual processes. He also emphasizes the need for proper training of such personnel who would undertake these scientific restorative treatments.

In the article entitled "Biodeterioration of Library Materials—Causes & Control" Dr. S. M. Nair, Director, National Museum of Natural History, New Delhi, elaborates the basic physical and chemical nature of paper and other library materials which make these susceptible to attacks by various biological agents which result in deterioration and decay. He diagonises each problem of fungus attack, insect attack, etc. and prescribes specific preventive and curative treatments with suitable biocides while suggesting relevant precautions as well.

Shri C. B. Gupta, the noted restorer attached to National Museum, New Delhi, in his article "Conservation of Paper, Palm leaf, Birch bark, Parchment & Vellum Manuscripts in Libraries" discusses problems of preservation of special materials in libraries and suggests the remedial measures for their safe upkeep and restoration.

Painting on paper poses some special conservation problems in libraries. The issue has been discussed at length in view of the special anatomy and chemical character of the colouring material. The author also suggests preventive and curative treatments for their proper preservation. Shri O. P. Agarwal, Director of NRLC, Lucknow has dealt with these issues adequately in his article "Preservation of Paper Painting".

Maps are another important item of library collection. Their oversize form, mode of use, storage problems deserve special measures for their proper preservation and use in the library. All these issues have been well elaborated by Dr. D. K. Mittra, the Map Librarian of National Library in his article "Conservation of Maps in the National Library".

The library collection is not restricted to books and paper based reading material alone. There are different forms of research materials which are now acquired for the library collection. One important acquisition is microforms *i.e.* microfilm, microfiche, etc. and other photographic records. The creation and conservation of these records, as part of the library collection, is one of the major responsibilities of a modern library. How the camera functions, quality of the film, the proper processing and scientific maintenance play a vital role in the creation and conservation of such records, have been amply discussed by Shri V. V. Talwar, the noted conservationist attached to the National Archives of India, New Delhi, in his article "Creation & Conservation of Photographic Records". He also specifies various scientific treatments for archival and library storage of such records for posterity.

The third section carries mainly the proceedings and the recommendations. The names of persons in the seminar organising committee and the list of participants have also been added. The recommendations highlight the importance and urgency for the proper conservation of cultural heritage in the custody of libraries, the meagre resources at the disposal of library authorities for proper conservation of library materials, the need for compilation and publication of directory of trained personnel, dealers of relevant stores and machines along with their specifications, creation of greater public awareness for conservation of library property, organising training classes for imparting scientific training for the conservation workers in the library. In all these aspects the recommendations envisage the leading and decisive role of the National Library, Calcutta, in the field of library conservation in India.

Research scholars in the field of conservation of library materials may find the select bibliography appended at the end of this publication useful for further study. This bibliography was compiled by our colleagues in the Bibliography Division and presented during the seminar. The bibliography has 1148 entries comprising of bibliographies, monographs, articles and standard specifications covering the period upto 1984. The entries are arranged under these heads and the entries in each section are alphabetically arranged to facilitate its use as an important reference tool for research scholars as well as a common reader. While compiling the bibliography both primary and secondary sources have been consulted. The bibliography does not claim to be comprehensive but it is quite extensive in its coverage. The books with Call Numbers are available in the National Library.

It is interesting to note few titles of the 19th century which have been included in the compilation. I make a special mention of these below because it is worthwhile to realise the foresight of persons who understood the problem of conservation many years before it actually becomes an issue of global concern.

1. J. Murray's Practical Remark on Modern Paper, 1829.
2. J. B. Nicholson's Manual of Art of Book Binding, 1878.
3. A. B. Gough's Preservation of Records of Ancient Sanskrit Literature in India, 1878.
4. H. P. Herne's Binding of Books, 1894.

The articles presented at the seminar and the bibliography cover a very large spectrum of topics in this important area of study. I hope that this compilation will be of interest to serious research scholars in the field of conservation of library materials in India and abroad.

KALPANA DASGUPTA
Librarian

NATIONAL LIBRARY, CALCUTTA
CONSERVATION SEMINAR

21st & 22nd January, 1985

21st January, 1985	*Inaugural Function*
11.00 A.M.—9.30 A.M.	Registration of delegates.
9.30 A.M.	Welcome Address by the Librarian, the National Library. Address by the Director, the National Library. Key note address by Shri P. B. Roy. Opening of exhibition and releasing of Souvenir by the Chief Guest, Shri P. B. Roy. Vote of thanks by the Librarian.
11.00 A.M.—11.30 A.M.	Tea.
11.30 A.M.	*General Session.* *Chairman* : Shri S. K. Mukherjee. 1. Importance of Conservation of Library Objects. —H. R. Sood 2. Education in Library Conservation in India. —Dr. A. K. Ohdedar 4. Conservation Movement in India.... —O. P. Agarwal
1.00 P.M.	Lunch.
2.00 P.M.—3.30 P.M.	*Technical Session* (II) *Chairman* : Sri P. K. Mahapatra. 1. Modern Book—a Problem. —A. Lal 2. Conservation Studies in Developing Countries. —R. Kishore 3. Preservation of Paper paintings. —O. P. Agarwal

	4. Map Conservation. —Dr. D. K. Mittra
3.30 P.M.	Group Photograph Tea & Reception.
22nd January, 1985	*Technical Session* (III)
10.00 A.M.	*Chairman* : Shri B. B. Chaudhury. 1. Conservation of paper based materials. —Y. P. Kathpalia 2. Biodeterioration of Library Materials. —Dr. S. M. Nair 3. Conservation of Palm Leaf, etc. —C. B. Gupta
11.30 A.M.	Tea.
12.00—1.00 P.M.	4. Conservation of Photographic Records. —V. V. Talwar
1.00 P.M.—2.00 P.M.	Lunch.
2.00 P.M.—3.00 P.M.	Going round the Technical Divisions (Conservation).
3.00 P.M.—3.30 P.M.	Tea.
3.30 P.M.—5.00 P.M.	*Concluding Session.* *Chairman* : Shri P. B. Roy. 1. Residual discussion. 2. Summing up. 3. Resolutions. 4. Vote of thanks.

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4. Group photograph of the delegates & participants of the Seminar on "Conservation of Library Materials" held in the National Library, Calcutta-27 on 21st & 22nd Jan., 1985.

1. CONSERVATION OF LIBRARY & ALLIED MATERIALS AND THE FIVE LAWS OF LIBRARY SCIENCE

PHANI BHUSAN ROY
Lecturer, Department of Library Science
Jadavpur University, Calcutta

Introduction :

The Fundamental Laws—their nature and development

All subjects during the course of their development give birth to certain fundamental laws which ultimately control the destiny and direction of further development of the subjects concerned till such laws themselves are modified or replaced. Such laws being of fundamental nature have the entire field of the subject as their area of application. All subjects of any sub-ordinate order falling within this area also become liable to application of such fundamental laws.

Because of this wide area of application externally such laws look very simple. However, application of such laws in different sub-ordinate areas under a subject reveals the depth in their meaning and applicability. In case of physical sciences, Laws of Motion, Laws of Thermodynamics may be cited as examples of such laws.

In Library and Information Science we had in India an outstanding scientist Dr. S. R. Ranganathan, who could give us some equally fundamental laws of Library Science. These Five Laws of Library Science are very simple in external appearance, but because of the depth contained in their meaning and implications they have been found to be quite helpful and effective in solving our problems and determining our course of action in any of the branches or sub-ordinate areas of Library and Information Science.

Five Laws Emphasize on Conservation :

Conservation of library documents is a very important sub-area of Library and Information Science activities. Theoretically speaking the five laws should have ample scope for application in this sub-area. We may refer to those Five Laws and see how they can help us in determining our course of action in developing a programme for Conservation of Library and Allied Materials.

Conservation and the First Law :

The First Law says that the BOOKS ARE FOR USE. The implication is that the libraries and information centres should encourage and ensure use of documents. The organisers of library and information services should also see that all the documents under their control are maintained in appropriate usable form so that they can be put to use any time whatsoever.

There is another side of the problem too. For whatever purposes books are used, whether as carriers of ideas contained in them, or as objects of art, as in a few cases they are, the use itself exposes the book to decay and deterioration.

The First Law, therefore, has two faces in this context. Through one face it directs a library scientist to encourage and ensure extensive use of documents under his own control. Through the other face it warns him about the problems of decay and deterioration of documents that are exposed to such extensive use. Very clear indications are that he should be aware of the problem and should take appropriate action in good time to see that the threat is duly met through measures which enable him to help the documents to recoup their good health or usability, so that further use is not hampered. The First Law, therefore, does not only create the problems of decay and deterioration of documents through its implementation. It also makes the librarian alert and aware of all the resulting problems so that he can develop his own strategy of preventive and curative measures through which documents could be maintained in their near normal health in spite of all uses. Any obstruction to free flow in the use of documents for reasons of ill health could be easily traced to disregarding the directions of the First Law in due time.

The First Law, therefore, is absolutely in favour of a planned and balanced conservation programme to ensure textensive use of documents without interruption.

A survey of the stack of the libraries in India will speak out volumes about our observance of the First Law in Indian libraries. We are largely possessive in nature and feel satisfied by acquiring as many documents as possible by our money. The problem of putting them to extensive use does not mostly bother us. Spending adequately on conservation programme to keep the documents in usable condition disturbs our mind very very mildly, if at all. That is why we provide ridiculously small amounts of funds for conservation of materials, almost as a method of self deception. An examination of the accounts of the libraries or even related budgetory allotments of funding authorities in the context of the requirement will support this contention. This outwardly miserly, but basically unscientific, atttiude forces many a librarian to seek the cheapest possible conservation services available to him. It is no wonder that a number of documents become unusable after such conservation treatment.

That is how the First Law is very much disregarded in the conservation programme of our libraries.

Conservation and the Second and the Third Law :

Perhaps it will be helpful if consideration of the Second and the Third Law could be taken up together. The reason behind this proposal is that both of them especially stress on the problem of putting a document and a user in contact with each other on the basis of their suitability or appropriateness. The Laws only look at the problem from two opposite directions.

The Second Law states EVERY READER HIS BOOK and the Third Law states EVERY BOOK ITS READER. The Second Law indicates that the users requirement may know no bounds. An alert librarian should be prepared to present any document that may be needed by an user in good usable form. The Third Law says that a responsible librarian should put to use in presentable form every document that has been acquired by him.

The direct implications of the two laws are that the conservation programme should cover the entire stock. No librarian can afford to be unduly selective in choosing documents for his conservation programme. He may have to develop his own priority programme for implementing different kinds of conservation activities but can on no account go too far about it by keeping aside, for pretty long time, some of his documents which need treatment.

Often under compulsion of miserly attitude in provision of funds conservation programme is trimmed and items of work are taken up on a very selective basis. Such action goes against the intention of the two laws and so moves against the interest of the users. Such an attitude is extremely unscientific no doubt but the fact that it very much prevails will be apparent from a casual survey of the shabby looking stack of a very large number of libraries in our country. This attitude is uneconomic too in the long run because it basically ignores the wise advice contained in the crisp popular maxim "A stitch in time saves nine".

Conservation and the Fourth Law :

The Fourth Law is crystal clear in its directive. It commands the librarian to SAVE THE TIME OF THE READER. It infuses an element of time in the conservation programme. The Law directs that different conservation activities should ensure performance of jobs not only soundly but speedily too. The users should not be kept waiting for any long time for the document not being available in usable form.

It implies that there should be a regular programme for taking preventive measures for checking against preventable decays and damages from rendering documents unusable. There should also be a regular survey of the stock to detect cases of different types of damages in their early stage so that immediate curative and restorative measures could be taken to bring back the documents to their previous stage of good health without any undue loss of time. The Law demands early action, planned action and time scheduled action too, so that the library and information centre is not exposed to cynical criticism of a dissatisfied user.

Unfortunately, however, it is a common misfortune for any user in any library of our country to often receive a cold reply in the circulation counter that the document required by him has been withdrawn from circulation for restoration work and for what not. Often he does not get any clear answer as to when the document may be available again. This is nothing short of blatant disregard shown to the Fourth Law on all consideration. If we wish to obey the directives of the Fourth Law in the present context it will be necessary for us to look into the reasons behind the slow work flow in conservation programme and deal with them appropriately.

Conservation and the Fifth Law :

The Fifth Law states that the LIBRARY IS A GROWING ORGANISM. It grows physically in quantity as well as in complexity or different kinds of internal relations. This quantitative as well as qualitative growth of the library and information centre is the result and product of similar quantitative and qualitative growth of all the components constituting the library and information centre. Conservation Unit, of whatever magnitude, will surely be one of the components of the library and information centre, which will face this growth problem in its own domain also.

As a result of increase in educational and research, technological and occational, socio-economic and socio-cultural activities, an increasingly large number of users will go on utilising the library and information services. As a result of this increasing utilisation of such services an increasingly larger number of documents will demand different kinds of attention from conservation point of view.

As a result of scientific and technological advances various types of documents will be produced which will need different kinds of materials and expertise for treatment.

Because of similar advances, different kinds of conservation materials, conservation machinery and equipment will go on being invented and manufactured for better handling of conservation problems.

This constantly changing situation will demand some open minded specialists with a starting stock of expertise no doubt but with an adequately dynamic attitude with capacity to absorb the needed quantum of newer technology and develop according to the exigencies of the situation.

The situation will, therefore, demand adequate funds for purchase of quality conservation materials, upto date machines and equipment, and quality services of experts for proper handling of the conservation problem.

The Fifth Law expects the librarians to be well aware of the development that is going on and that is due to come soon and also the problems that are being generated or are in the offing in the expanding universe of his library and information centre.

However, resolution of the crisis generated through this growth and development does not depend only on the librarian's awareness of the problems. Unless those who control the purse string are sufficiently responsive and inclined to solve the problems through provision of adequate funds, the librarians' knowledge of this expanding universe will remain in his mind as some additional doses of personal erudition. In the absence of appropriate financial support all conservation programme will go on failing much against the interest of the library and its users.

We need not be astonished when we find that in the name of economy badly damaged pages of documents are pasted with tissue paper in place of appropriate material, cheaper but uncertified variety of so called insecticide are selected for spraying on lowest price consideration. The ghost of lowest price often pushes many of our librarians to the arms of the mender with the lowest efficiency too. It is a common experience to come accross, in many libraries, mended documents which cannot be consulted freely.

The universe of binders whether attached to a library or working outside it, are obliged to be attached to materials, methods and tools of bygone ages and find themselves losing in performance in an unequal battle with their foreign counterparts. They are often blamed for their inefficiency but the true reasons behind this is never analysed for a scientific solution of the problem.

That is how we try to remain fairly static in an absolutely dynamic world where things are changing at a terrific speed. The Fifth Law is thus completely disregarded in conservation actvities of the Indian world of library and information services.

What is to be done for Conservation :

The above is only a very superficial examination of the conservation problem of the libraries in the light of the Five Laws of Library Science. A survey of the actual condition of things will clearly reveal that there is ample scope and need for improvement in conservation activities of our libraries and information centres. Conservation activities as one of the vital components of library and information services do demand some serious investigative attention to be paid to its problems, so that steps are taken for removal of lacunae that may come to notice.

In the situation in which we live in India, it may not be possible for all librarians to fight their conservation battle all alone, either against the administrative apathy, or against the underdevelopment in the world of specialisation in this area. Professional associations which are committed to fight for group interest may have to think of programmes for assisting their colleagues, who are in difficulty. Teaching a few some good techniques of conservation is no doubt a way, and a good way too, but its impact on the total problem will be pretty insignificant, and so, ineffective.

It will be helpful if we could make consistent effort for creation of professional opinion in favour of well planned conservation programmes, so badly needed by almost all types of libraries in India. If we could enlist the support of the state library associations for such activities, we could take such programmes to the very base of the public library movement in our country. The problem is gigantic and it calls for an equally big attempt to tackle it. Let this seminar be the first step for such a big effort. It is not just creating a row over a small problem. It involves huge amount of documentary wealth of the country which are getting wasted through ignorance and neglect. As specialists who claim to be aware of the problem it is our duty to place it before the social mind for its consideration. We should not, therefore, just discuss and disperse, because we cannot affort to do that. If we now turn a blind eye to this problem and thus hoodwink our conscience, the society may, at a future date, charge us for derelication of social duty.

2. IMPORTANCE OF CONSERVATION OF MANUSCRIPTS AND PRINTED MATERIAL

H. R. Sood
Officer on Special Duty
Raza Library, Rampur

Introduction :

Every year thousands of books, journals and newspapers etc. are printed in India and in foreign countries in a number of languages. Many of these publications reach the large number of Libraries, big and small, located all over the country. These are classified, catalogued and made ready for use of readers and are made available to them according to the rules of the Library. This is good as far as the current use of the material is concerned.

Ephemeral Material vs. *Old Material :*

There is no doubt that some of the printed material is of an ephemeral nature but some of the material published today is of outstanding and permanent value, not only for the current times, but also 100 years or so hence as it will give the future generations, an authentic idea of the state of culture, civilisation, political, historical and social developments in India and the world in the twentieth century. Today, we are overjoyed at seeing a book printed and published a hundred or so years ago and a manuscript written in an age of which we have no exact idea even. Apart from their contents even their binding, illustrations and general get up fascinates us. We feel instantly grateful not only to the great men who wrote them but also to the men who took pains to preserve the book over the centuries for the benefit of future generations. We also feel that the books should continue to be available to future generations also.

Apart from the sentimental and emotional values which are instantly evoked on seeing an old book or manuscript or a printing, the future generations have benefited greatly from the wisdom of the earlier authors. It is a well known fact that our rishis, who were great scholars, put their knowledge in manuscripts which are a storehouse of scientific knowledge in the fields of astronomy, medicine, astrology, spiritualism, philosophy etc. One wonders at the excellence achieved by these sages in understanding not only the universe but the intricacies of the human body also thousands of years ago. All this knowledge has come down to us because some thoughtful persons took pains to conserve these manuscripts over centuries. The whole mankind has benefited from the conservation of manuscripts and printed material over which our wisdom loving ancestors poured streamlets of thought, which ultimately developed into mighty rivers of knowledge.

Books for use must be healthy :

Although the first law of Library Science is 'Book are for use rather than their preservation', Libraries do take care that the books are not mutilated in handling and not destroyed or eaten by insects while stacked on the shelves in the Library. The Libraries have also to be careful from a certain type of readers who cut off pages, illustrations etc. from a book and even attempt to pilfer them. It is said that in the earlier times, books were chained to the shelves to prevent their being pilfered. Apart from mishandling and mutilation, there are other enemies like fire, water, rodents and vermins of various kinds from which protection is required. The climatic conditions also play a great part as dampness tends to shorten the life of the printed material whereas a cool atmosphere contributes to its longivity. Therefore, rare material should always be kept in specially air cooled space.

Fortunately, these days there is a general awakening regarding the need for preservation of manuscripts and printed material. Established libraries and even the general public is conscious of the rich heritage which has come down to us in the form of manuscripts and rare printed books and all efforts are being made to conserve the same. Simultaneously the current printed material is also being preserved in a number of institutions throughout the country. The Central Government, through the Department of Culture, is helping in a big way by directly administering certain institutions where such material is being conserved on a large scale. The State Governments are also contributing in this regard by taking care of the material in State Central Libraries and District Libraries. Many voluntary agencies, who are running public libraries, are getting financial help from the Central and State Governments for the maintenance of their collections. The Raja Ram Mohan Roy Library Foundation is also assisting the Libraries throughout the country by providing equipment which help in conservation of the material.

Policy for Conservation of Printed Matter :

For conservation, we are mostly concerned with the physical characteristic of a book and we have to take into consideration its binding, the type of paper used, the state of health of the book, etc. Moreover, each library has to lay down a criteria for the types of documents to be conserved and the period for which these should be conserved as one type of document may be useful for one library and may be a waste for another library. Also all documents cannot be preserved because of the constraints of resources and space and, therefore, the period for which the reading material should be preserved should also be decided in accordance with its importance for future use. Due care should also be taken, at the binding stage itself, to ensure that important information appearing on the dust cover of a book such as synopsis of its contents, like sketch of author, his photograph, etc., is included inside the bound volume as otherwise this important informations will be lost for ever.

Roll of the National Library :

In India, the responsibility for the conservation of printed and other material, almost rests solely on its National Library located at Calcutta. The National Library serves as a permanent repository of all reading and information material produced in India as well as for all printed material written by Indians and concerning India written by Foreigners wherever published and in whatever language. The National Library has a good collection of publications in all Indian languages and in English and other European languages and also in Chinese, Japanese, Arabic, Persian, etc. In addition, it has a rich collection of Sanskrit, Persian, Arabic and Tamil manuscripts and also of rare books. The Library's main function is to acquire and conserve all significant printed material produced in the country as well as abroad concerning India. Although the National Library has a Conservation Division consisting of a well equipped laboratory, bindery and a reprographic unit, still the facilities for conservation are woefully inadequate, both in terms of man power and equipment, to meet even its own departmental requirements not to speak of the needs of research scholars and institutions. The Conservation Division of the Library needs to be suitably expanded to make it a centre for provision of conservation facilities for the entire eastern region.

Conclusion :

The purpose of this article is not to go into the techniques of conservation of printed and other informative material. The main objective is to make the readers and the library staff conscious of the need for careful handling the book or any information material with a view to prolong its life. Special care should be taken in handling manuscripts which are very delicate and mishandling or even careless handling will easily destroy them. It should be remembered that printed material as well as manuscripts are 'fragile' and 'delicate' material and must be handled with love, affection and care. It would help greatly if librarians guide the readers in handling books and other information material carefully and make them aware of the need for conservation of the material for future.

3. CONSERVATION STUDIES AND PROBLEMS IN DEVELOPING COUNTRIES (*With a Special Reference to India*)

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Introduction:

Studies and investigations undertaken for conserving books, manuscripts and documents of intrinsic value have borne out that

(i) Preservation of these materials on scientific lines requires maintenance of optimum storage environment.

(ii) Acidity of paper being a vital factor bringing about rapid decay or disintegration of paper, its neutralisation without impairing the printing or legibility of the writing is necessary prior to its storage.

(iii) Handling and storage of weak and fragile paper need its restrengthening by a suitable technique for its subsequent physical safety.

Keeping in view the above, these three parameters form the nucleus of a comprehensive conservation plan and programme. It is, therefore, desirable to examine the various developments in these respective spheres, and have an appraisal of the equipment, aids and services available that would help the librarians or the custodians to take due care in preserving the important collections that have been entrusted to their hands by the past as an heritage, or that could likely flow to their hands in future.

Building and Storage :

As is well known, a control or regulation of temperature and relative humidity, the two agents of rapid deterioration of organic matedials, is a primary requirement of their scientific storage. Studies have shown that for most of the components that constitute book materials, a temperature ranging between 22-25°C and relative humidity between 50-55% represent the ideal storage climate. It is feasible to achieve such an environment only with the aid of airconditioning, which has to be provided throughout the year round the clock. This demands heavy machinery installation, its maintenance and operation in working efficiency, and needs finance which is often inadequate. Besides such an expenditure, very often the places or buildings in which our libraries or repositories are located are mostly make-shift accommodation. Housed in buildings which have been provided as gratis aid by patrons of learning, these are in need of repairs and renovations. Effective airconditioning of these buildings may need an expert advice before taking any further step in this direction. This is the first problem that needs in-depth study in a developing country where resources are mostly wanting for such an activity. It seems probable that the first requirement is that there should be a properly planned building with satisfactory layout which could satisfy the requirements of a healthy, scientific and systematic storage. With modern advancement in building material science, and architectural designing it is possible to obtain a mini climate inside a building which could be a modification of geographical climate of its location. For checking the incidence of high humidity, mechanical dehumidifying devices could also be adopted wherever desirable. Such an approach could perhaps provide an alternative to airconditioning plant, which needs maintenance and operational expenditure, besides the problems that are eventually to be faced by mechanical breakdowns and electric failures.

Another aspect that is linked with the scientific storage is the equipment available for the purpose. Very many aids could be provided today taking into consideration the media, type and format, proposed storage density and facilities for servicing, reference and retrieval. Providing the suitable material within the limitations of resources may perhaps require phasing out the present programme for the probable future needs. One of the recent advancement in the field of storage is compact shelving. In such a system the shelves move on rails and can either be drawn sideways or move backward or forward for opening or providing access to the stored material. With such shelving equipment it may be possible to provide for more storage density in a limited storage space. However, the experience has shown that these equipment are much more costilier than the static shelves, and there are problems of mechanical jamming etc. Taking into consideration the technological limitations in developing countries, it seems that static shelving equipment with adjustable shelves supported on angular slotted angle bars, shelf-supporting type could serve the purpose well. To suit the storage of outsize materials special plan or filing cabinets are also available. Any form and design of the storage equipment which provides physical safety to the materials and also facilitates quick retrieval and reference is preferable.

Biological Pests and their Control :

Inspect pests and variety of fungii that thrive on paper and other book components is perhaps one of the major problems confronted in countries in tropical and sub-tropical belt. Whereas maintenance of congenial climate as discussed above, help reducing the susceptibility of damage by these pests, the precautionary measures could further be reinforced by using repellent chemicals like naphthalene, camphoric preparations, spray of insecticidal solutions at places which show an abundance of these injurious agents. For getting rid of infestation of mildew, gastrallusindicus, popularly known as book-worm, book lice, etc. fumigation in vaults with thymol, paradichlorobenzene, ethylene dichloride carbon tetrachloride mixture, methyl bromide, and fumigation under vaccum with mixture of ethylene oxide and carbondioxide, provides the only alternative. A suitable vacuum fumigation chamber is a necessary requirement wherever such installation is within resources. It helps in quick sterilisation of all incoming materials to get rid of infestation and also undertaking a cyclic fumigation programme wherever an infestation is noticed among collections. Use of ethylene oxide is to be made under controlled conditions with appropriately trained personnel as its contact with human system either by exposure or inhalation for duration may prove harmful. Use of methyl bromide is progressively coming in use and suitable chambers could be designed either with masonry work or in form of a steel vault suitably lined with acid resistant paint or enamel. With the local know-how available in most of the developing countries such vaults could be got fabricated.

Pest control agencies which operate for agricultural products and fields may recommend a variety of chemical pesticides, insecticides or fumigants. A line of caution is to be adopted by the custodian of books and manuscripts since very many chemicals may affect, durability or permanency of paper or other book components, adversely.

Deacidification :

Besides environment, another challenge is posed by high acid content of paper. Studies conducted under the patronage of Royal Society of Arts had brought to the fore-front the evil influence of acidity on cellulosic materials as early as nineteenth century. In India too the studies conducted by Dr. Sudborough and Mehta under the patronage of Indian Institute of Science during 1921-22 had observed that the chief cause of perishing of paper in Indian libraries is the poor grade of paper having high acid content. Though neutralisation of acid in papers is an essential requirement for paper preservation, yet the first step in the direction was initiated by the pioneer in conservation Mr. W. J. Barrow. He introduced the first deacidification techniques with calcium hydroxide, bicarbonate solutions and also magnesium carbonate and magnesium bicarbonate solutions calcium. Subsequent researches in deacidification introduced a few more techniques such as vapour phase deacidification with B. H. C. (Benzene Hexamine Carbonate), Langwel's technique; Barium hydroxide in methanol emulsion, Bayer's Cops technique and large-scale deacidification in autoclaves with magnesium methoxide. Langwel has also suggested the use of inhibitions in papers for buffering the influence of environmental acidity, whose transmigration to paper often results in rapid decay. (Disodium pyrophosphate etc.). Investigations in this field which is now often taken as an essential step eventually required for "Preventive Conservation" are still in progress in Conservation Research Laboratories world over. Whatever be the trend in modern research in the field of acid neutralisation for preserving books and documents, the technique suggested by Barrow with Calcium hydroxide-Calcium bicarbonate solutions gives best answer for printed and other documents having water resistant writings. For documents in water washable inks, wherever such colours could withstand alkaline treatment, diluted ammonia fumes have been tried in National Archives of India, and could be adopted with advantage. Ammonium salts are likely to get decomposed during storage ; the treatment may need repetition in due course if necessary or desirable. This process is, however, economic as it needs no elaborate equipment and could be undertaken in a vault used for fumigation with liquid fumigants.

Restoration of Fragile Documents :

Restoration of papers that become weak and fragile is mostly necessary for their safe handling and storage. Very many techniques that make use of silk gauze (Chiffon) high grade light tissue paper, handmade paper with starch adhesives of a variety of formulations are in use in libraries and archives since the beginning of the twentieth century. The introduction of lamination technique using cellulose acetate foil and tissue paper under heat and pressure was introduced in National Archives of Washington with the collaboration of National Bureau of Standards. It was felt that the process will answer many restoration problems of libraries and archives, and flat-bed and rotary lamination presses were developed. Further researches in lamination techniques suggested the use of polythene for improving upon the properties of document laminates. It was, however, felt that many a document were not capable of withstanding heat or mechanised pressures. The National Archives of India developed a cold lamination technique making use of the ingredients adopted for machine lamination with the help of acetone. This process gave satisfactory and encouraging results. However, subsequent to post-war development there was a steep rise in the price of cellulose acetate whose properties were also considered not too stable for long range storage. Another process of 'Leaf casting' was developed in Israel, but being water-based technique this had limited applicability. Further it needs a sophisticated machinery which works on the same principle as paper manufacture on a small scale. Another technique recently put forth by Library of Congress, Washington is that of 'Encapsulation'. The document is only enveloped by sealing the edges of a plastic foil (Polyester) and there is neither pressure, nor heat or chemical deployed during such an encapsulation. How far these two techniques could be adopted for restoring bulk of documents that are in need of replacement is a matter to be considered. The probable technique or process that could be of help to restorers in developing countries is either cold lamination technique or the traditional use of high grade tissue paper with a paste. In early 1970 the National Archives of India tried a formulation with Sodium Salt of Carboxylmethyl cellulose indigenously available under the trade name Sarcell, for restrengthening documents with high grade tissue paper. This has given satisfactory performance and during the course of a decade over 8 lakh sheets have been restored. The results are encouraging and the technique needs fair trial as is reduces the cost of reinforcement substantially. There is yet another problem which needs a reference in this context —this relates to conservation of other organic forms, *viz.*, manuscript on palm leaf, bark, parchment and other like materials. The deterioration of these materials though could be checked to a good degree by providing storage environment already discussed, yet their restoration present innumerable problems and difficulties. Those countries which have long traditions and rich past culture have a vast collection of these manuscripts, and most of these countries are still in developing stage. Conservation Research Laboratories which have been now established (for instance, National Research Laboratory for Conservation, Lucknow, National Archives of India, New Delhi, National Library, Calcutta) are tackling these problems and some advancement for their treatment and reinforcement is likely in very near future.

Conclusion :

As will be evident from the foregoing discussions, conservation of books and manuscripts primarily calls for a stabilisation of the paper and other components. If such materials are used in early stage when these documentary material are created it will aid their future conservation in sound physical form. Adequate researches have been undertaken and the technological advancements and innovation have made it possible to produce an acid free paper. But the cost of production, and overall escalation of prices of printing and ancillary jobs of publication have necessitated newer media type such as microfilm, microfiche and other computer output media which are being put to more and more use. Further with the explosion in the domain of knowledge which has virtually crossed all thinkable frontiers—micro discs, which contain voluminous information in a small area have been made available. The stability and permanence of these products of recent technology are yet to be evaluated. It seems that time alone will decide as to what could be the best answer for preserving the heritage of the present times.

4. CONSERVATION MOVEMENT IN INDIA

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Introduction :

India is one of those very few countries which took the initiative of preserving her cultural heritage on a scientific basis at a very early date. Today, there are several conservation laboratories and departments to look after the nation's cultural property, although it must be admitted that even these are not sufficient in number.

The term "cultural property" has a wide meaning and is used to include monuments, art objects, ethnological objects, paintings, archival documents, library materials and other similar objects. All these types of objects, although connected to each other in several respects, have somewhat different types of approaches of conservation. For this reason, when considering the history of conservation movement in India, we will have a look at it from different points of view. Broadly speaking, these considerations can be :

(i) archaeological field—being mainly concerned with monument conservation.
(ii) museum field—concerned with art objects, paintings, decorative arts, sculptures, bronze images and quite often, manuscripts.
(iii) libraries—concerned with books documents, manuscripts and paintings.
(iv) archives—concerned with archival documents, manuscripts and other related materials.
(v) oil paintings.
(vi) research aspects.

An attempt will be made to present information in each of these broad areas.

Archaeological Material :

The first Archaeological Chemist of the Archaeological Survey of India was appointed more than sixty years ago with his headquarters first at Calcutta and later at Dehradun. This pioneer in the field was Khan Bahadur Mohammad Sanaullah. His duties included conservation and analysis of antiquities and also monuments including wall paintings. Reports of the early days can be seen in the various Excavation Reports or the Annual Reports of the Archaeological Survey of India.

Khan Bahadur Sanaullah was succeeded by an eminent scientist, Dr. B. B. Lal, under whom some of the most important developments in the field of conservation were to take place. Dr. B. B. Lal was assisted by Dr. S. Paramasivan, Assistant Chemist, whose work on the technical studies of wall paintings is well-known. Another luminary in the field of conservation was Mr. T. R. Gairola who was to be appointed as the Assistant Chemist incharge of the Conservation Laboratory attached to the Museums Branch of the Archaeological Survey of India. Later, Mr. Gairola came over to the National Museum to establish its Conservation Laboratory, which today ranks amongst some of the best in the world.

At present the Laboratory of the Archaeological Survey of India is headed by Director (Science), Mr. B. N. Tandon. The Laboratory has several zonal offices, in various parts of the country, to look after the conservation of monuments existing in their respective areas of action

Several State Departments of Archaeology have also established conservation laboratories to serve the needs of conservation in their States. The states having conservation laboratories include Rajasthan, Tamilnadu, Kerala, Madhya Pradesh, Uttar Pradesh, Punjab, Bihar, Gujarat, etc. Most of them are, however, still struggling to get more funds, equipment and staff.

Museum Material :

The Conservation Laboratory of the National Museum, although not the first to be established in the country, has its own place amongst the best conservation laboratories, not only in the country, but even outside. It was established in 1958, when the well-known Conservator, late Mr. T. R. Gairola was appointed its first Chemist with the given task to set it up on a scientific basis. Mr. Gairola started with a scratch and soon gave to it a very high standard. In the initial stages the number of staff given to the Laboratory was very small, but gradually as the importance of conservation work was realised, it was given more persons as well as equipment and space. The author who had joined the conservation field in 1952 in the Archaeological Survey of India, joined the National Museum in 1958 and was appointed Assistant Chemist, Deputy to Mr. Gairola in 1960. Those were the formative days of this great institution. Those were the days when the conservation laboratories were struggling to come on their own and to make a mark in all spheres. The author considers this period as a very important period of his career when he had the privilege of working with stalwarts like late Dr. (Mrs.) Grace Morley and late Mr. T. R. Gairola. Mr. Gairola and Dr. B. B. Lal gave a status and dimension to the conservation work, it never had before.

The National Museum Laboratory completed several important tasks like the transfer of the wall paintings from the Rangmahal, Chamba to the National Museum. This was the first time wall paintings were successfully removed and put in another place. After this first attempt, the laboratory was engaged in the transfer of wall paintings from the palace at Kulu and later on in a monastery in Sikkim.

Mr. Gairola remained the Chief of the National Museum's Laboratory till 1966 and contributed great deal to its development. In 1967 when Mr. Gairola took over as the Assistant Director, National Museum, the author was appointed the Head of the Laboratory. At that time efforts were being made to recognise the National Museum Conservation Laboratory as a central laboratory for museums in India. In a Report prepared by UNESCO Experts, late Dr. Paul Coremanas and Dr. H. J. Plenderleith, a recommendation of this type had already been made to the Government of India. In their report the experts had expressed an opinion that the conservation laboratory of the National Museum should be the training centre for South and South-east Asia. The report was under the consideration of the Government of India for a number of years and ultimately in 1972 the Central Conservation Laboratory was set up with the author as its first Chief Chemist and Head.

In its new set up, the Central Laboratory was to work for museums all over India, give advice and assistance to museums wherever possible. It had two main wings—one for scientific analysis and the other for conservation work.

Immediately after establishment the Central Conservation Laboratory of the National Museum had the distinction of organising the first Asia-Pacific Conference on Conservation of Cultural Property in collaboration with the International Centre for Conservation, Rome. The Conference was attended by participants from countries of South and Southeast Asia and Australia. Dr. Paul Philippot, Director of ICCROM at that time also attended and addressed the Conference. The Conference resulted in the publication of the book entitled "Conservation in the Tropics" (ed. O. P. Agrawal) which even to day has a relevance.

After the setting up of the National Research Laboratory for Conservation of Cultural Property in 1976, the role and the scope of the National Museum Laboratory was slightly modified with more emphasis on the work of the National Museum itself. Today, the National Museum Laboratory with Mr. A. S. Bisht, as its head ranks high amongst the conservation centres anywhere for museum work.

In the context of the museum conservation laboratory, mention must be made of the conservation laboratory of the Government Museum, Madras. This laboratory which celebrated its Golden Jubilee in 1982 was the first laboratory of its kind to be established in India. After its establishment it grew in strength with the consistent efforts of another veteran scientist, namely Dr. S. Paramasivan whose work on the conservation and examination of wall paintings in India is well-known. The first electrolytic reduction plant for the treatment of bronze images was also established at this laboratory. Mr. N. Harinarayana, the present Director of Museums of the Tamilnadu State was the Conservation Officer of this Laboratory for a number of years and under his guidance the Laboratory was further strengthened and developed.

The period after 1960 could be termed as a period of great importance and of great fervour for conservation movement in India. It was during this period that the importance of having well-equipped scientific conservations laboratories was being gradually realised. Thus conservation laboratories were established in national institutions like the Salar Jung Museum, Hyderabad, the Indian Museum, Calcutta, the Victoria Memorial, Calcutta, and several other institutions. Several States also realised that conservation was an important aspect of museum work and they set up their own conservation departments. An important conservation department to be thus established was of the Department of Museums of the Gujarat Government. The Director of Archaeology and Museums of the Rajasthan Government also appointed an Archaeological Chemist for conservation work. Today, several States like Punjab, Bihar, Kerala, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh and others have big or small conservation sections and laboratories.

It is a matter of great satisfaction to the author that in this development the National Research Laboratory for Conservation has played an important role. A survey of the conservation needs in India which was conducted by the author on the request of the Department of Culture in 1976 indicated that the situation of conservation in various States was very dismal. The Survey Report was forwarded by the Department of Culture to the Chief Secretaries of various States and it had a very salutory effect.

Archival Material :

Today, the National Archives of India at New Delhi is the premiere institution in the country for record-keeping and archival work. It has its genesis in the Imperial Record Department (IRD) which was established in 1891 with its main objective of maintaining the records of the Government of India. The Imperial Record Department, after independence, with increased scope and responsibilities was reorganized in 1947 as the

National Archives of India. However, the Research Laboratory for conducting research in paper preservation was established much earlier in 1942. Its first incharge was Shri S. Chakravarti, Archival Chemist. This Laboratory conducted research in the techniques of fumigation, insecticidal treatment and other repair techniques of archival documents. The Laboratory which was started at a small scale was developed further for conducting investigations and experiments on various aspects of conservation of documents in 1947.

The National Archives' Laboratory has to its credit the well-known Solvent Process of Lamination of documents with cellulose acetate foil. It already had with it the hot bed laminating machine which is capable of turning out work at a great speed. The National Archives has a well-equipped department of micro-filming and other techniques of reprography.

Much credit for the development of the conservation wing of the National Archives of India goes to Mr. R. C. Gupta, who joined the National Archives in 1950 as Preservation Officer, redesignated as Assistant Director of Archives (Preservation) in 1952. His consistent efforts enlarged the scope of archival conservation bringing to it a scientific outlook and provided to it a much needed system.

The research wing of the National Archives of India had the benefit of the services of another scientist, Mr. Ranbir Kishore, presently the Chief of Conservation Department who joined the Archives in 1950 and was soon put incharge of the Laboratory. The Reprography Unit of the NAI owes much to Mr. Chari, and some other Scientific Officers of the Archives have been invited abroad several times for consultation and advice. Yet another name one should mention in this connection is that of Mr. Y. P. Kathpalia. Mr. Kathpalia has rendered valuable service to the cause of archival conservation.

Today the National Archives Conservation Department is the focal point for training and conservation work in the country. Trainees from outside India take part in its training course which is a course of its own type in this part of the world.

With the consistent efforts of the National Archives of India, most States in the country today have State Archives to look after the records and documents in their individual States.

There are very few libraries in the country having a conservation unit of their own. In this respect the National Library, Calcutta has given a lead. It has with it a well-developed conservation facilities. The conservation work in the National Library is handled by three units, namely the laboratory unit, the preservation unit and the reprography unit.

Library Material :

The laboratory unit was set up for testing of various types of materials to be used for preservation. The preservation unit looks after the repair and the binding of important and rare books. The conservation work is done under the guidance of Mr. Avinashi Lal, Dy. Librarian.

The reprography unit has facilities for micro-filming, as well as for photo-copying. The service is in great demand by the scholars as well as by the general public.

The Library arranges training courses and seminars from time to time.

Oil Painting :

Oil paintings are a class by themselves because their structure and materials are different from other types of paintings. Attempts have been made to establish Restoration Studios for preservation of oil paintings in various collection. The National Gallery of Modern Art, New Delhi appointed a Restorer, Mr. Sukant Basu nearly twenty five years back and sent him for training to Italy at the Istituto Centrale del Restauro, Rome. The National Gallery has further added to the facilities of this work and are now conducting a training course in this very important area. Lately Mr. Sukant Basu has gone over to the National Museum as Chief Restorer.

The Prince of Wales Museum, Bombay sent Mr. S. Andhare for training at the National Gallery, London. Mr. Andhare worked at the Prince of Wales Museum, Bombay for a number of years and restored several paintings. However, recently he has shifted from the Prince of Wales Museum, Bombay to direct the activities of the Lalbhai Dalpatbhai Museum at Ahmedabad.

Another person to be trained abroad in the area of restoration of paintings was Mr. K. S. Natu, who was working at the Museum and Picture Gallery, Baroda till he retired.

Another fine restoration studio for oil paintings has come up at the Victoria Memorial Hall, Calcutta where Mr. Arun Ghosh after training in U.K. is working on the paintings in the collection of this Institution.

The Salar Jung Museum, Hyderabad also has a Restorer, Mr. Karni on its staff. The collection of oil paintings in the Salar Jung Museum, Hyderabad is very important and all efforts have to be made for its preservation and restoration.

Recently, some work on the restoration of oil paintings was done at the Mohammad Ali Shah Picture Gallery, Lucknow by a team from the

National Research Laboratory for Conservation of Cultural Property. The paintings were large size portraits of Nawabs of Awadh, displayed in the Gallery. The results are very encouraging.

National Research Laboratory for Conservation of Cultural Property :

A very important development in the field of conservation research has been the establishment of the National Research Laboratory for Conservation of Cultural Property in 1976. The Government of India had set up a Committee of Experts in 1972 to study the ways and means of co-ordinating the research activities in various areas of conservation and to make recommendations to the Government of India. The Committee chaired by Mr. Chandrakant, Joint Secretary (Technical) to the Government of India and members like Mr. M. N. Deshpande, the then Director General, Archaeological Survey of India, Dr. B. B. Lal, Chief Archaeological Chemist, The Director, Anthropological Survey of India, Mr. A. B. Chandiramani, Joint Educational Adviser, Ministry of Education and several other eminent persons recommended to the Government that an independent national institution for high level research should be set up. The recommendations were accepted by the Government and as a result it was decided to set up the National Laboratory.

The author was charged with the responsibility of preparing the project, recruiting the necessary staff, getting them trained, identifying the research programmes and obtaining the required scientific equipment. The Laboratory was fortunate enough to have the support of UNDP and UNESCO for its establishment. Several scientists were trained abroad under the UNDP project as also most of its equipment was obtained under the same programme.

At present the Laboratory with its headquarters at Lucknow has attained an international status and a wide recognition of its work. It has some of the finest equipment available anywhere, has an excellent library devoted to conservation and above all a team of devoted scientists and conservators. It has with it equipment like X-ray Fluorescence Spectrometer, Emission Spectrometer, Atomic Absorption Spectrophotometer, X-ray Diffraction equipment, Matallurgical and Petrological Microscopes, Infra-red Spectrophotometer, UV/Visible Spectrophotometer and several other pieces of equipment useful for longterm research. Several research programmes are already going on.

The Laboratory also provides technical assistance to institutions in India, as well as outside India on request. It has undertaken several important conservation projects for the restoration of important art materials. An example is the conservation of large size wooden Bhuta images at the Crafts Museum, New Delhi.

The NRLC's training programmes—one of six months duration and the other of ten days—are attended to by trainees from India as well as from countries outside India. UNESCO awards some fellowships to trainees coming from abroad.

The NRLC has close links with ICCROM, Rome and with other international organisations like the International Institute of Conservation of London and the International Council of Museums Conservation Committee.

Indian Association for the Study of Conservation :

The establishment of a professional academic organisation, namely the Indian Association for the Study of Conservation of Cultural Property can be considered a landmark in the conservation movement in India. This Association of conservators was founded in 1966 as a result of a seminar on conservation of cultural property, convened by the Conservation Laboratory of the National Museum. The seminar was arranged to coincide with the visit of the Director of the International Centre for the Preservation and the Restoration of Cultural Property, Rome, Dr. H. J. Plenderleith who had come to India to attend a UNESCO seminar on Development of Museums. The Seminar received all support from the then Director of the National Museum, late Dr. Grace Morley. Dr. Morley had a vision and interest in all aspects of museum development and conservation, ranked high in her plans.

The Seminar of 1966, the first of its kind in the country, was inaugurated by Mr. A. K. Ghosh, at that time Secretary in the Ministry of Education of the Government of India, and was addressed by Dr. H. J. Plenderleith. It was at this Seminar that the author of this paper proposed the formation of the Indian Association for the Study of Conservation of Cultural Property. As was expected, his proposal was immediately agreed to and he had the privilege of being the founder-Secretary of the Association (IASC), in which capacity he continued for several terms. Late T. R. Gairola played a very active role in the formation of this institution. Since its formation, the IASC received guidance from its founder-President, Dr. B. B. Lal, the then Chief Archaeological Chemist.

The Author also proposed that the papers which were presented at the first Seminar be compiled and edited in the form of a journal. The Journal was initially brought out in a cyclostyled form and was entitled "Conservation of Cultural Property in India". Five volumes of this journal were brought out in a cyclostyled form and from the sixth volume onwards with the financial support received from the Ministry of Education and Culture of the Government of India it is being printed. The author also had the distinction of being the first Editor of this journal in which capacity he brought out several volumes.

Mr. Ranbir Kishore was the Secretary of the IASC for a number of years and gave a fillup to many of its activities. The Association to-day is making continuous progress with Mr. A. S. Bisht, Chemist of the National Museum as its Secretary. It is the only forum in the country where conservators can meet and can discuss their common academic problems. The 1984 seminar is to be held at Calcutta from 10 to 12 December.

Indian National Trust of Art and Cultural Heritage:

A very recent significant development in the area of cultural heritage is the setting up of a voluntary organization for development of cultural heritage. The organization is the Indian National Trust for Art and Cultural Heritage, functioning under the chairmanship of Mr. Rajiv Gandhi. Mrs. Pupul Jayakar played the key role in establishing the Trust. The INTACH has plans to assist and to take up conservation of art objects as well as monuments and historic sites, particularly those which are not protected either by Centre or by the States. It has plans to set up a Documentation Centre as well as Conservation units. Its impact is already being felt in the country. It has set up "INTACH Conservation Centre" at Lucknow for execution of conservation work.

Conclusion:

As will be seen from the above brief description; the conservation movement in India has had a modest but firm beginning with the establishment of the laboratory of the Archaeological Survey of India, that of the Government Museum, Madras, of the National Museum. Great developments took place after independence, particularly in the period the movement got support from persons like Dr. (Mrs.) Kapila Vatsyayan, till recently the Additional Secretary in the Department of Culture who had done all she could for the establishment of conservation laboratories in the country. Much emphasis has been placed on conservation in the Seventh Plan. At the recently held meeting of the Secretaries of States convened by the Ministry of Education and Culture on the 6th July, 1984 emphasis was given on the preservation aspects of cultural work. In her inagural address Mrs. Sheila Kaul, the then Minister for Education and Culture said that "we require many more museums to protect and preserve the abundantly rich cultural heritage of the country which may be lost to posterity if neglected". The National Council of Arts under the Chairmanship of the Prime Minister of India has also given directive for effective conservation of Cultural property. With all these efforts at the highest level one can hope that this important aspect of work will continue to receive the attention it deserves.

5. EDUCATION IN LIBRARY CONSERVATION IN INDIA

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Introduction :

Although acquisition and dissemination of information are the primary functions of libraries, conservation is also an important and indispensably necessary function. The primary functions will greatly suffer if the acquisitions of information is not well conserved. Collections of books and other forms of document must be kept physically fit for being used. The existence in a library of physically unfit or damaged documents has little meaning since these documents are hardly of use and as such may be taken more or less as lost.

The need for library conservation is particularly urgent in tropical and sub-tropical countries. Because of climatic and environmental conditions library materials in these countries are prone to be adversely affected or damaged to a great extent very soon. Unless care is taken properly and in time, the damage becomes irrepairable. It was J. A. Chapman, Librarian of the Imperial Library, Calcutta, who visualised the problem as early as 1919. He published an article entitled 'An enquiry into the cause of the perishing of paper' in the *Calcutta Review* of July, 1919. In this article Chapman also referred to the "Inquiries held and a report published by the Royal Society of Arts 1898", and said, "All the enquiries stopped short at the very point at which it is so very important that they should be taken up in India, for the tendency for paper to perish is so intensified in this country that thousands of existing books will be lost, unless means are discovered in time to ensure their preservation. It is a reasonable opinion, too, that the view taken in Europe was a short-sighted one."

Paper Deterioration :

Deterioration of paper—still the largest medium for recording information—or of film, tape and disc—the newly growing media, is mostly chemical deterioration. And chemical deterioration is caused and hastened by too hot or too dry, too wet climate, or by ultra-violet radiation. These causative factors are prevalent more in countries like India than in Europe. Yet the problem of conservation has been felt in Europe, particularly after the second World War, owing to the following situations : enormous production of various kinds of documents, growth of many mammoth-size libraries, commercial production of very inferior quality of paper, and the atmospheric and environmental pollution. So library conservation as a subject has become of increasing interest in Europe as is evident in the growing study and research in it, the starting of instructional courses and other activities in it including the establishment of institutions and organizations solely devoted to conservation. Thus in 1950 was founded in London the International Institute for Conservation of Historic and Artistic Works. It aims to provide a permanent organization for coordination and improving the knowledge and methods of working standards needed to protect and preserve precious materials of all kinds. It provides information on research into all processes connected with conservation, both scientific and technical, and on the development of these processes. Mention may also be made of the Institute of Book Pathology, Rome which, as its very name suggests, is primarily concerned with library conservation. The evidence of the growth of study and research in coneservation is seen also in the publication of some journals on the subject. Of these, mention may be made of the *Studies in Conservation*, the quarterly organ of the International Institute for Conservation, London ; *Restaurator*, the International journal for the preservation of library and archival materials, published twice in a year from Copenhagen ; *Museum*, a quarterly journal published by UNESCO, which is of much interest to librarians and archivists ; and *Library Conservation News*, recently published from the British Library, which is a current awareness bulletin.

Training Facilities in Conservation in India :

We have said that the need for conservation is particularly urgent for countries like India. Unfortunately, although quick deterioration of documents has been a common feature of our libraries and archieves, no serious efforts have been made for the development of education and research in conservation, science and technique. After Independence there has been a rapid increase in the number of various types of libraries—public, academic and special, including libraries of many learned and research institutions. This phenomenon has made the need for conservation all the more urgent.

Education in conservation should be both formal and informal. The informal education is to arouse public awareness for conservation requirements and the right behaviour with books. The formal education should be conducted in universities and special schools or institutions, and should be at two levels : one at a higher level for conservators, or in other words, conservation scientists ; and the other at a lower level for technicians. The lower level education, somewhat moderated to put emphasis on preservative conservation, should be also for librarians and archivists so that they are in a position to take measures to prevent decay of and damage to documents or records and render first aid to the sick ones and then call a specialist, if necessary. The higher level education should lead to research. And conservation being a technical subject, research in it is to be, as is the case of any other technical subject, mostly applied research carried on for the development of conservation methods, tools and materials suitable especially for Indian conditions.

The present state of formal education in conservation in our country is appallingly poor. It will not be any travesty of truth if we say that education in library conservation is practically non-existent. Although as many as 43 universities in different parts of the country are offering library education at the undergraduate level, and 17 universities are offering the education both at the under-graduate and the post-graduate levels, while 6 universities conduct in addition to the two levels of library education research programmes leading to Doctoral degrees (the figures may be taken as valid upto 1980), yet in all these courses and programmes conservation has remained a neglected subject. In the B. Lib courses what is given as lessons in conservation is a bit of theoretical knowledge of binding and preventive conservation, the subject being treated as part of a single paper. Most of the M. Lib courses do not at all include conservation. Only a few have a paper on archives management, which touches some elementary aspects of archival conservation. The students do not get even a clear knowledge as to the concept and scope of conservation. Such being the fate of conservation in library education, the question of its having a place in the research programmes in library education does not arise.

The National Archives of India is conducting in its School of Archival Studies a 12-month Diploma course in archival studies. This course is an enlarged version of the former short-term course run by the institute for quite many years in the past. The present course includes the study of conservation in all its major facets, *viz.*, (1) Nature of library/archival materials ; (2) Enemies of library/archival materials ; (3) Preventive care against physical, biological and chemical deterioration and against disasters such as fire, floods, windstorms ; (4) Curative treatment : Repair and Restoration. Details of the course are given below :

Optional subject : Paper 3—Conservation.

A. Theory :

1. Introduction to Preservation.
2. Loose paper, palm-leaf, birch-bark, leather, ink, papyrus and synthetic materials.
3. Housing of manuscripts and records : (i) Shelving system—their advantages & disadvantages ; (ii) Storage of files, bundles, documents boxes, books & volumes, maps, charts and photographs, machine readable records and audio-visual materials, storage environmental conditions ; (iii) Servicing of manuscripts and records for use by scholars ; (iv) Fire detection and fire protection, security measures against theft and vandalism.

4. Building : (i) Functional requirements and essential features ; (ii) Improvements in an existing building for scientific conservation.

5. Enemies of records and control measures : (i) Causes of decay of paper ; (ii) Biological deterioration—insects including termites, mildew infestation, rodents, etc. ; (iii) Physical deterioration—effect of heat, light and moisture ; (iv) Chemical deterioration—effect of ink, atmospheric gases, pollution, dust, acidity in paper ; (v) Fumigation—various techniques.

6. Restoration : (i) Principles of repair ; (ii) Washing, deacidification and flattening ; (iii) Adhesives, their preparation and use ; (iv) Manual repair processes ; (v) Mechanical methods of restoration ; (vi) Binding of manuscripts, library books and volumes, methods, materials and equipments ; (vii) Special problems—seals, palm leaf repair, paintings, maps, *etc.*

7. Requirements of a Conservation Unit : (i) Planning of small repair unit ; (ii) Cost of various restoration processes ; (iii) Training of craftsmen.

B. Practicals :

1. Pagination, washing and deacidification.
2. Humidification and flattening.
3. Minor repairs, full pasting, half margin repairs, inlaying, etc.
4. Tissue repair, chiffon repair and docketing.
5. Solvent lamination, machine lamination.
6. Air cleaning and fumigation.
7. Preparation of pastes, determination of pH value and use of preservative chemicals, etc.
8. L. P. mixture dressing, gathering and guarding, stiching and binding, sectioning, repair of maps, etc.

As is apparent, the course although fairly comprehensive in its coverage is too heavily loaded for one single paper. And then why should the course be optional ? It means that a student of archival studies may dispense with conservation education. Is it desirable ? The optional course may serve as preparatory to specialized studies. But there must be a compulsory course for all students of archival studies. On a similar pattern, the University courses in Library Science may have an optional course in addition to a compulsory course in library conservation.

It is a happy augury that the National Library, Calcutta, has started imparting training in conservation. Last year (1984) it conducted a short-term training of two months' duration. The course covered the following theoretical and practical programmes.

> Theoretical Course : History of book ; History of writing materials including palm leaf, etc. ; Characteristics of old paper and new paper including history of paper and testing of paper ; Natural ageing of paper ; Biological deterioration of paper ; Control of biological and natural decay of collections in Indian conditions ; Storage of books and documents ; Repairing methods of damaged documents including water demaged documents ; Binding techniques ; Inks and their effects ; Conservation planning and organization including personnel ; Repairing materials and equipment ; Protection against hazards like fire or floods, etc.
>
> Practical course : Book examination for preservation ; Binding of books ; Mending of books ; Map mounting ; Deacidification by different methods ; Protection and preservation of paintings ; Repairing and rehabilitation of documents including manual lamination ; Machine lamination ; Pastes, their formula and preparations ; Preservation of leather binding ; Management of water damaged documents ; Fumigation methods ; Disinfection ; Stain treatment ; Use of fungicides, insecticides, fumigants and rodenticides.

This training programme, like the course taught at the School of Archival Studies, National Archives of India, and is too heavily loaded trying to cover almost all the aspects of conservation. However, it is hoped that the National Library will not merely continue this training, though in a moderated form, but with all the rich resources at its command, will make every effort to give the training a greater status. In fact it is urgent that the National Library establishes its own School of Library Conservation to develop education in constrvation at both the higher and the lower levels.

Suggestion and Conclusion :

At the Second International Conference of Directors of National Libraries on resource sharing in Asia and Oceania, held in Tokyo on 15-19 November 1982, the following was among the recommendations passed :

"In order to prevent the deterioration of printed materials caused by tropical conditions as well as by chemical reactions in paper itself, the Conference recommends :

(a) That each country formulate effective preservation policies ;

(b) That assistance be sought for the improvement of facilities for training and research in conservation in the region ;

(c) That assistance be provided to countries in the region without conservation laboratories to establish such facilities.

These recommendations are significant for Asian countries. We should take the advantage of these recommendations as soon and as best as possible. In this connection it is heartening for us to see the recent establishment of the National Research Laboratory for Conservation of Cultural Property at Lucknow. Although this organization set up by the Department of Culture, Government of India, is mostly concerned with archaeological conservation, it is expected that it will duly extend its activities towards library and archival conservation. It should in collaboration with the National Archives and the National Library undertake the following activities :

(i) To formulate effective conservation policies for the country ;
(ii) To develop facilities in all the parts of the country for formal education and training library & archival conservation at different levels ;
(iii) To set up conservation laboratories and equipments with adequate personnel ;
(iv) To develop research in conservation ;
(v) To publish journals and current awareness bulletins on conservation and also books specially suiting the Indian needs ;
(vi) To organise library and archival conservation workshops and camps ;
(vii) To make available the services of specialists to institutions on request ;
(viii) To keep close contact with foreign and international bodies and institutions concerned with conservation of library and archival materials so that interchange of ideas and information is readily effected.

We have already referred to the need for informal education in conservation. This education should be fostered by the National Research Laboratory for Conservation, the National Archives, the National Library, and the universities and institutions which conduct courses in library and archival studies. To promote this education the following programmes may be undertaken :

(i) Setting up of exhibitions ; (ii) Organising public lectures ; (iii) Organizing film and television shows and radio talks ; (iv) Preparing video programme cassettes ; (v) Publishing pamphalets and popular literature ; (vi) Involving the Film Division to produce documentaries on conservation.

Let us hope that education in conservation will soon spread in our country. The more this education, the more protected and preserved will be our rich cultural heritage.

6. EVOLUTION OF CONSERVATION ACTIVITIES OF THE NATIONAL LIBRARY, CALCUTTA

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Introduction :

History of the preservation activities of the National Library, Calcutta, may be better termed as "evolution", because it would trace the life story of gradual growth of a wing which is a continuous process and which had its nucleus formed in the remote past. But this growth must be viewed in the context of the growth of the National Library itself.

Genesis of the Library :

A library is a growing organism, so is the case of National Library, Calcutta. For all practical purposes its origin could be traced in the formation of the Calcutta Public Library in August, 1835, which was the manifestation of a joint endeavour of the intellectuals belonging to the English and Indian Society of Calcutta. The small initial collection of this Library grew from the donations of private individuals enriched by valuable donations consisting of 4,675 books from the College of Fort William.

At the time of its genesis the infant Library had no regular housing accommodation. The library had to be housed at the private residence of Dr. Strong at Esplanade Row from 1835 to 1841. The Library had to be shifted to the Fort William College at Writers' Buildings during the period from 1841 to 1844. This housing problem drew the attention of all concerned and, after joint manoeuvring of both public elite of Calcutta and Government, a massive building was raised at the junction of Strand Road and Hare Street which came to be known as Metcalfe Hall where the Calcutta Public Library had its regular accommodation from the middle of 1844. Since then Calcutta Public Library "languished under low management" and this state of things continued for more than half a century till Lord Curzon came to India as Viceroy. It was his endeavour and foresight that brought into being the "Imperial Library" with a collection of 1,00,000 books on 30th January, 1903 by amalgamating the Calcutta Public Library and the Secretariat Library.

Growing Problem of Conservation :

On further analysis it is found that the Library's collection grew chiefly through three channels by purchase, by gift, and by operation of the Registration Act, 1867.

The housing problem at different stages of the Library's growth during its infancy and the heterogeneous sources of the book collection only added more to the dimension of the problem of conservation during subsequent years.

Early Conservation Activities :

It is seen that three basic measures had been adopted for safeguarding the collection of the National Library (the then Imperial Library) since its genesis such as :

(1) Binding and encasing of books, periodicals, Gazettes, newspapers etc.

(2) Legs of racks and almirahs had been provided with metal (iron pans) filled with solutions of phenyle and kerosine oil to check white ant attack.

(3) Dusting of books, etc.

It may be pointed out here that this binding of Library books used to be got expedited through Government Press, and unskilled coolies used to be employed for the dusting and cleaning work of books etc. once a week. By 1905 it was felt that dusting of books by coolies was unsatisfactory and as such the possibility of employing better staff for this work with more pay was considered. In 1906-07-08- Dusting Bearers had been employed for dusting and cleaning of books and the idea was to employ more such staff for thorough cleaning in view of the increasing strength of the book collections. From the year 1908 it is found that Library authorities had started taking care of maps and as such 573 maps were found to have been restored during this year.

J. A. Chapman, the great conservator :

An epoch making awareness for proper conservation of the wealth of books in this Library grew with the appointment of Mr. J. A. Chapman who stewarded the Library as Librarian from 1911 to 1930.

Mr. Chapman inscribed a special place for this Library in the world map of conservation of library materials. He was a great Librarian-Conservator, and a man of vision. He first observed that a quieter neighbourhood than the Strand Road was desirable for housing the Library. He also discovered that binding of Library books through Government Press was unsatisfactory, and, as such, deputed Mr. Schelfield to Cambridge for acquiring proper expertise for improvement of Library binding. The idea of welfare of library book collection hunted his mind in multiple ways. He was terribly upset by the tendency of book paper perishing in the Imperial Library. He thought of two initial measures for the possible solution of this problem.

Mr. J. A. CHAPMAN (1911-1930)
The great Librarian-Conservator of the Imperial Library, Calcutta.

He, in his single minded initiative and endeavour, had established some of the basic principles of Library Conservation Science which are eloquent testimony of his far sightedness and vision.

(i) To preserve duplicate copies of Indian publications in England.

(ii) Contacted Dr. Caldwell, Prof. of Chemistry, Patna College and Mr. E. G. Hill, Principal, Mair Central College, Allahabad for finding out solutions of books perishing.

He felt equally concerned with the damage done to books by book worms, for which metal pans filled with solution for fighting white ants proved ineffective. He thought of painting the cover and fly-leafs with some solutions for preventing attack by book worms. He also experimented with closed shelving and also suggested the use of asbestos-cement sheets in racks construction.

He also dreamt of a special department for restoration of brittle, worm eaten and damaged books for which he felt the necessity of skilled restorer.

Chapman visualised the desirability of a new library building, being removed, as far as possible from the presence of Howrah smoke and Calcutta coal gas. He also wanted to be benefitted by the experience of librarians in countries having similar climatic conditions for fighting insect problems. He also felt concerned about high humidity in Bengal in which the paper perishes and ink fades. He, therefore, intended to provide some mechanical protection to books which would tend to prolong the life of paper.

In 1915-16 he created a small special department for repairing of brittle, worm-eaten and torn books.

Subsequent to 1916 he entrusted the Indian Institute of Science, Bangalore, to investigate into the causes of perishing of paper in tropical and sub-tropical countries.

The year 1918 witnessed an all India awareness about the importance of libraries and their proper functioning for the upliftment of the society. The "All India Conference of Librarians" held in Lahore in this year passed a number of resolutions, of which one was on "Preservation of Book Papers".

It appears the Chapman's awareness regarding the perishing of books in libraries was much more advanced and keen than his contemporaries. Chapman himself went on deputation for two months (September-October, 1919) to Indian Institute of Science, Bangalore, for personal supervision of investigation work and its findings. On getting the report he came to the conclusion that paper does not perish at places in India at an altitude of 5000 ft. and upwards.

Thus he suggested two alternatives :

(1) to remove all such valuable books to a library located in Hill stations where climate is temporate.

(2) to place such books in a library and to equip the library with air-conditioning plant so that temperature and humidity can be carefully controlled all the year found, day and night.

Of these two he strongly recommended the latter :

(i) to avoid damage of books due to transit,

(ii) the life will be longer, and

(iii) temperature and humidity being controlled and air filtration being ensured the books will be less liable to attack by micro-organisms than they would be in the damp climatic conditions of certain hill stations.

He also recommended that the whole library building would be subjected to air control not only in the storage areas but also in the reading rooms.

It appears really unique that when scientific and technical advancement was not upto the desired level, Mr. Chapman in his single minded initiative and endeavour had established some of the basic truths of library conservation science which is an eloquent testimony of his farsightedness and vision. It may also be pointed out here that library conservation science is generally a post nineteen thirties manifestation. Therefore, Mr. Chapman's concept and activities on library conservation at least, a decade earlier could be treated as pioneering and remarkable. From this view point Mr. Chapman can be very befittingly called as "Father of modern Library Conservation".

The National Library in its 26th year of establishment of Conservation Wing and on the occasion of this "Conservation Seminar" pays deep homage and respect to Mr. Chapman, the great librarian-conservator of Imperial Library, Calcutta.

The Languishing Period :

From the beginning of nineteen thirties upto late nineteen forties the conservation activities of the library continued as a matter of routine and there had been no new activities except that the library authorities thought of procurement of air-conditioning plant which did not materialise due to paucity of funds from the Government of India.

Khan Bahadur Asadulla who steered the library during this period, was, however, very meticulus in keeping the library collection free from dust which went a long way to maintain the books from being attacked by insect, fungus etc. He also upheld the cause of conservation in a noble form. He introduced "Librarianship" training class in which he incorporated "Book Binding and Repairing" as a major device for book conservation in the syllabus as an integral part of "Library Organisation and Administration". He started the class in 1935 which continued upto 1946 and trained as good as 86 candidates.

The Library however, faced a problem of betting large number of damaged books bound by the Government of India Press. Problems also cropped up to get back books in time after binding which adversely affected readers' service. There had been also the problem of loss and further damage of books during transit to and from library, and Government of India Press. Moreover, Government of India Press did not co-operate in accepting books according to the requirement of library. All these facts compelled library authorities to discontinue this system and start the binding of books through outside contractors from early nineteen forties. Steel racks had also been put to use for better shelving of books of the library.

In the meantime, India achieved independence and this not only brought new life to the whole nation, but also created new material conditions for the unique development of this library along with its conservation activities. Resurgent people of India indentified new meaning of life and embarked upon a programme of reconstruction of their material and intellectual existence.

B. S. Kesavan, the Chief Architect of modern conservation activities.

Incidentally, B. S. Kesavan, joined this institution as Librarian. He stewarded this library for more than a decade and elevated this institution to national and international significance.

The Imperial Library, in the meantime, assumed the name of "The National Library," Calcutta in 1948. After the dark days of war the collection of books had been shifted from Jabakusum House to Esplanade and re-shifted to Belvedere, the new and permanent home of the National Library.

Acquisition of books, manuscripts, periodicals, etc. increased considerably due to monumental donations such as Sir Asutosh Mukhopadhyay Collection, Ramdas Sen and Baridbaran Mukherjee Collections, etc. (1949, 1950, 1953). The D. B. Act (1954, 1956) was a new official move to get more Indian publications. There were exchange programmes such as the Exchange Agreement with Academy of Science (USSR, 1953), Wheat Loan Exchange Programme (USA, 1954), International Agreement of Exchange of Publications (Paris, 1956), Agreement with Canada (1956) and new exchange programme with U.N.O. and its various agencies. There was also a steep rise in new additions of monographs and serials through regular purchase.

Shri B. S. Kesavan reorganised this institution on functional basis befitting to its national and international obligations. As a result, Acquisition, Processing (Classification and Cataloguing), Bibliography and Reference, Stack, Reading Room etc. divisions came into being. But the combined activities of these divisions alone could not meet the total obligations of this national institution. Shri Kesavan identified this lacuna and took the decision to have a technical unit which would take care of publications both old and new (monographs and serials) and keep them in good physical condition. It would undertake both preventive and curative measures for the proper upkeep of books for giving the present readers and scholars and preserving them for future generation.

Shri Kesavan made an objective assessment of the existing system of book binding. A tiny unit as a component of Stack Division used to select and prepare books for being bound by outside contractors. It was observed that this system was suffering from multiple limitations and inadequacies which fell much short of desired requirement of quality and quantity.

Shri Kesavan identified this problem but could not do away with the existing system readily. So he intensified the binding activities by employing two or three contractors at a time to achieve more production of binding in a given time. Considering the urgency of binding and repairing Shri Kesavan undertook a special project in 1957 for binding of British Parliamentary papers which are considered valuable documents for research.

Genesis of Nucleus of Modern Conservation Unit :

But Shri Kesavan decided to change this system and started taking measures to do it. But he needed a trained person to execute this new work. With this objective in view he sent Shri B. B. Chaudhuri on deputation to National Archives of India, New Delhi in 1954 for being trained in the modern scientific techniques of conservation and subsequently deputed him to U.S.A. for further expertise in preservation techniques under Wheat Lean Exchange Programme, 1957. The nucleus of the present Preservation Wing had its genesis in the formation of a tiny Mending Unit consisting of three menders in June, 1957. As an inevitable impact of organic growth this process gathered momentum and with the assistance and advise of Shri B. K. Roy, Manager, Government of India Press, Shri Kesavan brought the Home Bindery into existence in August, 1958 with 1 Foreman, 5 Binders, 4 Gold Finishers and 4 Labourers which eventually became a fullfledged Preservation Division with a formal Assistant Librarian (Shri B. B. Chaudhuri) as Head of the Division in September, 1959.

Shri Kesavan, however, did not depend only on the expertise of Shri B. B. Chaudhuri who acquired his specialization recently, but also utilised the

SHRI B. S. KESAVAN
(1948-63)
The first Librarian of the National Library, Calcutta. He put life to the conservation activities dreamt of by Mr. Chapman and established modern scientific Conservation Wing of the National Library, Calcutta.

expert advice of Mr. John Alden (1958) a renouned U.S. Expert on conservation of library materials and wise suggestion of Shri R. C. Gupta, Dy. Director, National Archives of India, New Delhi for further strengthening of the newly formed Preservation Division (April, 1959).

Shri Kesavan realised that the physical preservation through the process of binding/repairing should be supplemented by chemical conservation and reprographic conservation. As such he moved the Ministry as far back as 1956 for setting up a microfilming and photoduplication unit in the National Library "which will result in considerable space being saved for storing and it will be possible to deal more satisfactorily with rare, very old and brittle or irreplaceable books". He also conceived the idea of setting up a chemical laboratory and desired to equip it with a Vaccum Fumigation Chamber in 1956 "in order that rare books and manuscripts may be saver against insect attack". For administrative difficulties repeated efforts procure the necessary equipment failed since then. Subsequently efforts to to procure them through India Wheat Lean Educational Exchange Programme in 1958 from U.S.A. also did not materialise. In the meantime, the foreign exchange position of the Government of India became difficult and the aforesaid procurement remained postponed for an indefinite period. It seems that Shri Kesavan became impatient and addressed a letter to Shri Krishnamurti, the then Dy. Secretary to the Government of India in 1960 stating "Meanwhile, the demand for rare and precious books is increasing and constant handling of this material will be ruinous unless the proposed units are set up immediately".

Shri Kesavan not only endeavoured to build up the different conservation units for better preservation of the wealth treasured in the National Library, Calcutta, but also to uplift the awareness for conservation of books and manuscripts in different libraries, archives, etc. all over India. He availed of the opportunity when Mr. John Alden, a noted U. S. expert on conservation visited India under Wheat Lean Educational Exchange Programme in 1958. Shri Keshavan organised Mr. Alden's tour to noted archives, libraries all over India, who also submitted his report suggesting possible development measures for conservation in these institutions to the Government of India. Shri Kesavan also organised group lectures by Mr. Alden for the students of library science of the Calcutta University and organised training lectures for senior librarians, conservationists deputed by various institutions and libraries from all over India.

Efforts for expansion :

In the meanwhile, the infant Preservation Division had a promising start under the capable guidance of Shri B. B. Chaudhuri, as Assistant Librarian. It had basically three components, namely Preparatory, Restoration and Bindery Units, which used to do the binding, re-binding, repairing restoration, lettering, etc. after due selection and preparation of the damaged and loose items. This physical process of treatment, however, could not bring any remedy to many a problems of the centuries aged collections of this library, suffering from fungus attack, insect infestations, acidity, brittleness of paper based materials which inevitably called for measures involving use of chemicals. Therefore, circumstances necessitated to embark upon a new programme of chemical activities also, which called for the formation of a laboratory. Soon after the Preservation Division started functioning, it was proposed to start the work of laboratory in November, 1959 which read accordingly "Now that the Preservation Division has started functioning it has become necessary to equip it with a "Laboratory". The main function of the laboratory at present will be to guide the use of proper chemicals and insecticides, fungicides for safe keeping of the vast collection of this library as also the efficient and scientific application of modern methods of conservation". For this it was also proposed to staff this unit with the following hands :

(1) Chemist—1.

(2) Laboratory Assistant—1.

Although the recruitment of the proposed staff, took time it was, however, decided immediately to build up the laboratory step by step. Accordingly few technical hands of the Preparatory Unit had been pressed into service for organising the laboratory by procuring elementary chemicals, instruments, furniture, etc. It was at this juncture that the library authority came to appreciate the difficulties of organising and building new technical units for conservation of library materials without adequate trained manpower. Accordingly two of the Junior Technical Assistants working in the Preparatory Unit namely Shri A.C. Das and Smt. S. Sengupta were deputed to National Archives of India, New Delhi for training in preservation of books and documents along with photoduplication techniques including microfilming in September, 1961. The following table indicates the extent of service rendered during the five year period (1961-65).

	Deacidification	*Fumigation*	*Stain Removal*
1961-62	2,708 leaves	—	—
1962-63	5,187 ,,	—	—
1963-64	2,305 ,,	16076 vols.	—
1964-65	9,750 ,,	1749 ,,	1155 Nos.

Increasing awareness and pressure of conservation work through chemical treatments prompted the library authority to propose to the Government of India for creation of the posts of :

1.	Senior Chemist (Class II Gazetted)	1
2.	Laboratory Assistant	1

for manning the proposed laboratory in December, 1961.

While the newly born Preservation Division continued its steady growth both in terms of manpower and production capability (in quantum and variety) and the formation of nucleus of the Laboratory Division thus ensured, the work in connection with the setting up of the Photoduplication and Microfilming Division did not also lag much behind. It was observed that the old, rare and valuable books, manuscripts, newspapers were badly affected due to adverse climatic conditions of urbanised Calcutta. Such items were ruined further due to constant handling by the ever increasing number of readers. The tight foreign exchange hurdle delayed the procurement of the necessary equipment and stalled the growth of the proposed Reprographic Unit. But necessity knows no law. The demand for rare and fragile collections increased so much that National Library had to get the publications pressing readers' demand photostated or microfilmed through outside agencies namely Indian Statistical Institute, Calcutta-35, M/s. Focal Craft, Calcutta-29 & M/s. B. K. Saha, Calcutta-25. The practice, although not suitable for a national Institution like this library continued up to the setting up of the regular Reprographic Division.

Preservation Division had to shoulder the responsibility of the joint Government of India—UNESCO Microfilm Project (1966-67) in which services of several hands working in the Division had been utilised including services of the Assistant Librarian. The Assistant Librarian had to accompany the UNESCO Expert with his mobile microfilm equipment and visited at least 38 institutions, libraries, archives, etc. throughout the country and microfilmed 1232 rate manuscripts in Sanskrit, Arabic and Persian comprising of 2,28,352 pages.

A stirring incident and advent of modernisation :

In the meantitme, Preservation Division had been substantially strengthened with the joining of the Chemist on 30th July, 1965. Consequently the activities of the Laboratory Unit of this Division had been intensified with the acquisition of more apparatus and ingredients to cover new items of work. Nevertheless some of the most important scientific conservation work continued to suffer badly due to delay in the installation of few basic machines and equipment namely Vacuum Fumigation Chamber, Lamination Machine, Microfilm Camera and other photographic equipment and material like cellulose acetate foil, etc. for which clearance for import from the Government of India was being awaited. In this context a historical and most stirring incident took place which accelerated the growth of the Preservation Division which could not be achieved even after more than a decade's endeavour. One Journalist Shri Chanchal Sarkar published a striking report in Hindusthan Standards (23rd June, 1966) by name under the Caption "A challange for Chagla" highlighting the fact that proper conservation of books and documents in the custody of National Library had been suffering for lack of suitable equipment and machines. This report triggered a hue and cry in the Parliament and the then Honourable late M. C. Chagla, Union Education Minister air-dashed to Calcutta to visit the Preservation Division of this Library on 11th July, 1966. Shri C. R. Banerji, the then incharge Librarian aided by late Acharya Suniti Kumar Chatterjee, National Professor took him round the Preservation Division and showed him the different conservation activities. Shri Chagla was very impressed and could appreciate the needs of this library. He, on his return, instantly conveyed the sanction of 5.10 lakhs of rupees covering the total expenditure required for procurement of basic equipment for Microfilming and Photography, Lamination Machine, Vacuum Fumigation Chamber, etc. This incident is a landmark in the history of development of activities in connection with conservation of library materials of the National Library. It has helped to put the laboratory on scientific footing and to move towards modernisation of conservation activities.

This incident invigorated the so far anaemic Preservation Division. More and more fresh chemical activities and new work load necessitated the formation of an independent Laboratory Unit and in the month of February, 1968 the new separate Laboratory Division came into existence with chemist as head of the Unit.

After the receipt of the sanction from Government of India hectic efforts were made to procure necessary machines, equipment and stores for strengthening the conservation set up and activities. Accordingly order was placed with D.S.&D., Calcutta, for procurement of microfilm equipment *vide* Order No. PRN(M)|857, dated the 8th December, 1966. Immediately proposal for creation and recruitment of staff against the following posts was made on 27th December, 1966 so that machine could be put into operation as soon as these are received in the library.

1.	Asst. Librarian	1
2.	Michophotographer	1
3.	Asst. Microphotographer	1
4.	Photo Assistant	2
5.	Laboratory Attendant	2

Orders for procurement of cellulose Acetate film for reinforcement of fragile books and documents had also been placed early in the beginning of 1967.

The much awaited microfilm equipment with accessories were received in the library towards the end of 1968 which provided material base for the setting up of the Reprography Division. Consequent upon the joining of Shri A. B. Roy as Microphotographer and later on as Assistant Librarian, the Reprography Division started functioning formally in May, 1969.

It is well known that National Library, Calcutta, is the treasure house of cultural heritage of mankind in the form of rare and invaluable books, manuscripts, maps, etc. As the collection has been growing since many years the effect of aging on them became very pronounced. The adverse effects of humid climatic conditions, insects, fungus, acidic gases due to unhygenic storage conditions, necessitated proper storage area for the old and rare books. It was decided to house at least the most precious rare collection in an air-conditioned place (RH 45% to 55% and Temp. from 65°F to 75°F). When this specially designed hall covering an area of 2,760 sq. ft. on the ground floor of Annexe building was completed, the Rare Book Division started functioning which was formally opened in January 1970 by Shri S. S. Dhawan, the Governor of West Bengal. In the first instance nearly 3,000 most valuable and rare books and manuscripts were housed in this special hall which continued its steady growth during subsequent years and its present strength of books and manuscripts, etc. is about 8,000.

The cellulose acetate film having been imported from U.S.A. in the year 1971 and with the lamination machine being received in the library from Yugoslavia on 22nd September, 1973 the library instantly switched to the machine lamination process, adding more speed and elegance to the finished products than the products of hand lamination. The Vacuum Fumigation Chamber the only effective means for treatment of worm infested books was procured in the library in July, 1977. Although its installation took time due to administrative and technical reasons it has since been put into operation capable of undertaking the treatment of more than 1,000 worm affected books at a time.

The Present Set-up and its vital role :

What started as a tiny mending units in June, 1957 with three menders, gathered necessary momentum during subsequent years. To-day's Conservation Wing of National Library consists of four technical Division manned by nearly 100 qualified staff including three Assistant Librarians, one Microphotographer, one Chemist and supervised by one Deputy Librarian.

Conclusions :

The Preservation Branch as such played a very fruitful and significant role since its birth in preserving the cultural heritage treasured in this library inthe form of books, manuscripts, maps, govt. pubs., serial pubs., etc. Now in terms of manpower, equipment and other resources it commands an honourable place in discharging the functions of this national institution.

National Library by virtue of its status has always played a role "friend, philosopher and guide" among sister institutions and libraries of the country. Throughout the period of its growth this national institution always stood by the sister organisations and has rendered moral and material help at the time of their need. This very spirit and feature had always been manifested in the entire period of development of the conservation activities of the library also.

In fact the conservation wing of this library always acted as "Bureau of Advice" to weaker institutions by assisting them in organising their conservation activities and undertook inspection of endangered collections on request and advising them for suitable remedy and solution. Technical advice has been rendered to numerous institutions and libraries for promotion of conservation activities at their end. To name a few who have so far been benefited by such advice are Bangiya Sahitya Parishad Library, Calcutta ; Asiatic Society Library, Calcutta ; Record Office of Calcutta High Court ; Uttarpara Public Library, Hooghly ; Khuda Bux Oriental Public Library, Patna ; Hazar Duari Palace Library, Murshidabad, etc. Some times the Conservation Department of this library had to rush for rendering material help for salvaging reading materials in the custody of other libraries. It has also been organising training of in-service personnel deputed by other institutions and libraries in modern methods of books binding, repairing and other techniques of library conservation.

The shortcoming and efforts for rectification :

It has been observed that this training was given only on request from desiring institutions but it did not serve the desired purpose. It was, therefore, decided to start a regular course for giving training in modern scientific methods of library conservation. Accordingly a regular curriculum was drawn up consisting of both theoretical and practical teachings and a regular training class in conservation of library materials has been started from the year 1983. National Library has already completed two library conservation deputed by institutions and libraries all over India, such training programmes of two months duration in which as good as 25 in-service candidates have been trained both in theory and practice of namely Bihar, Dehra Dun, Kohima, Hyderabad besides different districts of Bengal including Calcutta. This training is henceforth a regular annual feature. Its primary aim is to help libraries and institutions who have rich collections in their custody, but lacking in resources and technical know-how in this field. Mr. H. R. Sood formerly Officer on Special Duty took the initiative in organising this training and got it materialised and put into practice a long awaited concept, befitting this national institution.

The conservation wing of National Library has a very significant and meaningful growth during this short period, but this growth is by no means proportional to its efficient functioning conducive to its high responsibilities and obligations. It lacks desired degree of co-ordination among the various Conservation Divisions, weak in productive potentiality because of lacuna in its organisational structure and lack of well defined guideline of its functioning. It is also unfortunate that still the staff who are engaged in conservation of cultural heritage of mankind have not yet been given due status including pay scales. Shri H. R. Sood, with his administrative farsightedness discovered this dismal region of conservation activities of this Library. With his capable handling Shri Sood moved the Government of India who set up a special Committee consisting of National Experts on conservation in 1982 to study the present set up and activities of Conservation Wing of the National Library and recommend suitable measures for its reorganisation and strengthening. The Committee members were (i) Shri O.P. Agrawal, Project Officer, National Research Laboratory for Conservation of Cultural Property, Lucknow (ii) Shri Ranbir Kishore, Chief of Repair and Conservation, National Archives of India, New Delhi (iii) Shri R. C. Gupta, Ex-Dy. Director, National Archives of India, New Delhi and (V) Shri A. Lal, Dy. Librarian, National Library, Calcutta. The observations of the Expert Committee had duly been submitted to the Government of India in January, 1984 and it is understood that the recommendations are well under active consideration of the Government of India.

The Promising Future :

The construction of new building for housing the Conservation wing of this Library have already started where all the Conservation Divisions could function in an integrated, well co-ordinated and more scientific way. On the other hand a unique development is going to take place shortly *i.e.* the National Library is going to organize a seminar on "Conservation of Library Materials" in January, 1985, the first of its kind in this Country.

Thus material conditions have been created in such a way that Conservation Wing of this Library is on the threshold of a big qualitative change.

7. MODERN BOOK—A PROBLEM TO THE LIBRARIANS

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Introduction :

Twentieth century has seen a boom in the book production. Libraries grew up, to provide books to the masses in most of the civilized and cultured societies. There arose the problem of upkeep of collections. Even the best of the well maintained libraries got disillusioned with the conditions of the books and there arose the most popular demand "Conservation of the Library Stock".

In any Library, book is the information carrier and a book today is mostly on modern paper manufactured in paper industry. This paper is characterized by its property of losing its strength when kept in storage. This loss of strength renders the book as not remaining a source of information effectively. The use of such a book needs either to be restricted or its strength is to be reconstituted to the original level, or the information be transferred to another carrier : *Librarians are therefore concerned in the book conservation from the various stand points :*

(1) Structure of the modern paper which needs to be changed to more permanent form.

(2) Temperature and humidity to be controlled to reduce the rate of aging in library.

(3) Libraries should locate damaged material and restrict their use till restored.

(4) Transfer of information to other carriers.

(5) Undertake restoration of weakened material.

(6) Control of damages due to insects and other pests.

Policy of Conservation :

Conservation of the library materials requires library management and expert technicians working hand to hand. Management determines the clear objectives of conservation and technicians endeavour to reach those objectives. Hand made papers behave quite differently under storage conditions than the machine made paper with which most of the libraries are concerned today. Quality of paper is the main concern of today's book.

Modern Book Paper :

Manufacture of right type of paper is therefore the demand of the librarians. Paper technology can be divided into two segments (1) pre 1800 A.D., and (II) post 1800 A.D. Paper manufactured before 1800 was almost hand made paper. The use of alum, which is a double salt of aluminium and potassium of sulphuric acid causes strong acidic reactions. It destroys calcium carbonate in solution and also the fibres of cellulose before they reach to sheet form. Alum until today has been thought to be important for proper sizing of the machine made paper in combination with rosin. Recently *i.e.,* in 1956, a new technology developed which eliminates the alum. The new process uses alkylketone dimers which do not need alum and do not work well in acid medium. A pulp with completely eliminated lignin with calcium carbonate as filler and alkylketone dimer for sizing will give a good permanent paper. The stability of such paper is quite similar to handmake paper of pre 1800 A.D.

The product of this new technique is just like hand made paper and has alkaline reserve, which is an important factor for permanency of paper. It is likely to take time for this process to be adopted in a big way in paper manufacture. It is for the librarians to emphasize the need of the permanent paper and to desire and to promote its application. This may involve a little more cost by a about 25%, but that will be balanced by the longer useful life of the books and subsequently more availability of funds for future purchases of newer materials than replacements. It is again upto the librarians to make their influence felt in selecting publications on durable and permanent alkaline paper. In U. S. A., this idea has effected the book production, and now it is estimated that about 25% of the publications are on alkaline paper there.

Alkaline Reserves in Paper :

Leaving the choice of paper for a book, if we come down to our existing stock, we find that the stock of the present day book paper is acidic and needs to be protected against acidic degradation. This is achieved by deacidification. Deacidification has a preventive effect. The principle in deacidification lies in filling alkaline earth compound which react with the carbondioxide of the air to form carbonates causing the pH to rise to 7.0 +. Saturating the paper with alkaline earth compound is done by bathing as in acquous solutions like calcium hydroxide and calcium bicarbonate solutions or magnesium-bicarbonate solution or solution of barium hydroxide octahydrate, in methanol or spraying the paper with such solutions.

The pH of an acidic paper can be raised by use of gaseous diethyl zinc. This process has the advantage of being useful even in bulk quantity of books and without being disected. The process is yet under observation.

Deacidification fixes up the acid compounds in the paper which hydrolise the molecule chain of cellulosic fibre. A buffer is created in the paper. A catalytic check of the oxidation of the cellulose is attributed to this alkaline reserve. Oxidation creates reactive groups which can cause cross linking. Carboxyl groups are also created by oxidation. In case of calcium buffering it is found that 3% of calcium carbonate by weight gives effective protection. Acquous method can strengthen slightly decayed paper by washing away the break down products and thereby reactivating the hydroxyl groups forming new hydrogen bonds during drying in the fibres or in the cellulose molecule.

Restoration of Damaged Paper :

Deacidification stabilizes the paper. Slightly damaged papers will become again useful after the deacidification but more damaged ones will need strengthening. The precondition of restoration is that the documents should be properly examined, nature and extent of damage is ascertained and to the extent to which restoration is possible is decided. There are various techniques of restoration, both conventional and modern. Aim of restoration also depends according to the likely use of the documents. Restoration always aims at maintaining the originality of a document, but the end use may not permit it. A brief discussion about the types of restoration in vogue, today is :

(a) Sizing : Slightly damaged parts can be put back to work by using gelatin, animal glue, starch, poly acrylate, methyl cellulose, etc., in suspension of water.

(b) Lamination : Papers which have lost strength and have been brittle due to acid or biological ravages can be strengthened by lamination, using adhesives either natural like starch pastes or glue, or synthetic compounds like, polyacrylate, polyamides, polyvinyl alcohol, etc., in combination with tissue paper. The lamination can also be done by using thermoplastic film like cellulose acetate film or polyethylene films.

It is important that the materials used should not be corrosive to the paper. It is also necessary that all the processes of restoration must be reversible. Recently electrostatic method has been used in the process of encapsulation with polyester films which are very strong, clear, neutral and resistant to wrinkling.

(c) Splitting the paper : In cases where a damaged paper can be split into two a strengthening leaf, can be introduced in between. This method has the advantage that the originality of the printed or written surface of the paper is not disturbed.

(d) Fibre Casting : Fibres in the form of fine gel can be casted on damaged leaf. Fibre casting is effected through a machine. The process is useful in cases where the edges are damaged.

Microfilming :

Paper has its age and therefore although every effort can be done to protect and restore it into original form, it may become essential to transfer the data or the content on another carrier. This is effected by photography. From the point of conservation the most appropriate transfer is microphotography on permanent type of halide film with polyester base or cellulose triacetate base. Positive films are allowed for use, while the negatives are properly stored for conservation and future printing.

Air Conditioning :

Books on paper or film will continue to decay under normal conditions. Lowering of temperature slows down the chemical activity and thus reduces the rate of decay of the materials. Books and other such materials and films stored in air conditioned space with 50% R.H., 72°F. temperature with the in-coming air filtered off the acidic gases and dust, will keep their life considerably long. If these factors are controlled, that is there is proper selection of the fibres, adequate and proper treatment of pulp, deacidification and repairing if needed is done and storage conditions are maintained, it is not difficult to keep the books for a few centuries.

8. CONSERVATION AND REPAIR OF PAPER BASED MATERIALS

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Introduction :

Paper is a versatile medium on which everything human beings are proud of has been recorded at some time or the other. It has been used from earlier times and is being used even now for recording the day to day working of a Government, writing by authors, painting by painters, drawings of engineers, etching of artists, notes of musicians, legal and administrative happenings, blue prints of architects and industries, for photo-prints, newspapers, learned journals and glossy magazines, packaging and facial tissues and even as insulating material amongst other uses. Such is the versatility of paper. One has to have ingenunity to use it.

Paper :

The main constituent of paper is cellulose which in its original form is permanent. It is only when it (cellulose) is used for manufacture of paper with the help of chemicals, it undergoes changes which though helpful for the purpose, *i.e.,* fabrication of paper, yet put in ingradients for its destruction. The mechanization of the manufacturing process is one factor that is responsible for the poor state of paper based materials in our times.

Early Paper :

Paper in the olden times was made by hand with small quantities of weak chemicals. These chemicals obtained from natural products did not deteriorate celluose. But the same cannot be said of the modern mechanized processes of manufacture of paper. Strong chemicals used not only degrade cellulose but also leave residues which are acidic in nature, help in oxidation, hydration and degradation of cellulose fibre and result in breaking down of the cellulose chain thereby affecting the degree of polymerization.

Modern Paper :

We know that alum is acidic, so is chlorine which is used for bleaching. We also know that the process of digestion which converts raw materials into cellulosic pulp degrades cellulose if not carried out properly. Also impurities like iron and copper besides other metals, which creep into cellulosic pulp, act as nuclei of deterioration, yet all these steps are necessary for the production of paper by machines.

To make a paper which is both durable and permanent what is required is proper formulation, proper control, proper methodology and standardization of the technique of manufacture. If these can be enforced or followed, paper as good as the best of handmade paper can be had.

Deterioration and Preservation of Paper

Conservators unfortunately have no control on the manufacture of paper, which is dependent on parameters which differ from need to need and use to use and other constraints mainly financial. Nevertheless deterioration of paper whether machine made or hand made can be counteracted and minimized by resorting to scientific preservation techniques.

Preservation constitutes two aspects, preventive preservation (conservation) and curative preservation (restoration).

Preservation :

(i) Preventive preservation (Conservation).

(ii) Curative preservation (Restoration).

The steps that constitute preventive preservation (conservation) include :

(i) Use of good quality paper and ink.

(ii) Proper handling, storage and servicing.

(iii) Ensuring proper environmental climate for storage.

(iv) Fire prevention and security.

(v) Neutralization of acidity *i.e.,* deacidification.

While curative preservation (restoration) involves :

(i) Deacidification prior to restoration.

(ii) Restoration by either traditional or modern processes.

(iii) Docketing, boxing and binding as required.

Preventive preservation

Preventive preservation means taking steps to retard decay or deterioration and to take measures against agents responsible for such decay or deterioration *viz.,* insects, fungi, rodents, light, heat, moisture pollution, acidic chemicals, dust, fire, mishandling and vandalism besides other acts of nature. Most of these can be controlled by :

—Good house keeping *viz.,* cleaning, use of insecticides and fungicides.

—Environmental control.

—Proper storage and building which provides protection against these agents of decay or deterioration.

—Security measures.

Heat and moisture

It has been observed that control of temperature, humidity, dampness and storage in containers help to retard the decay of paper and thus contribute to preservation by increasing its shelf life or longivity. The ambient condition of temperature 22°C ± 2°C and relative humidity 50% ± 5% have been observed to give best results in tropical and temperate region countries. These conditions for countries in cooler regions would, of course, be different. The temperature there would be in the region of 14°C to 18°C and relative humidity from 55% to 65%.

Insects and fungi

Damage caused by these can be prevented by keeping the storage area as well as the materials on paper clean *i.e.*, free of dust by means of vacuum cleaner, removal of cobwebs, etc., spraying insecticidal solutions* on the floor and walls and use of fungicides** as and when necessary.

Fumigation

Insect infestation can be controlled by fumigation only, either by the traditional processes or by vacuum fumigation. The latter is an effective process but the equipment is costly and the process of procurement of ethylene oxide, an essential ingradiant of ethoxide, used for fumigation is combersome. Also latest studies in United States indicate that repeated use of ethoxide is harmful for the workers as well as the users. Modern techniques like the use of gama-rays which pose radiation contamination problems. However, Kathpalia has used sterilization in an oven with microwaves to ensure uniform temperature of 60°C and 50% relative humidity for eliminating pests and fungus infestation. So far no harmful affects have been noticed or reported.

*There are a number of formulations available in the country such as Finit, Sheltox, Pip and Smtox.

**Blotting paper or brown kraft paper dipped in 5% solution of thymol in methanol or 5% solution of orthophenylphenol in rectified spirit are effective as deterrent against fungi.

For developing countries there the constraints are financial as well as lack of trained personnel, the alternative is to use a mixture of thymol and para-dichlorobenzene in the ratio of 25 grams to 1 kg. respectively per cubic meter of space in an airtight room fitted with shelves and exhaust fans or air extractor or in a specially constructed chamber for a period of 14 days. Another process that is effective against fungi as well as insects is fumigation with formalin. This process can be adapted for mass fumigation. Work on it is in progress and positive results are expected in the near future.

Building

A good building scientifically designed contributes to proper housing of documents and provides protection against light, heat, moisture, dampness, insect infestation, fire, vandalism, flood and earthquakes and also against ravages of war. The designing architect must consult a conservation archivist or expert to achieve this purpose. There are instances of new buildings that have come up all over the world which meet the above requirements. There are also as many that have been constructed or are under construction which, I am sorry to say, do not provide such protection, yet these are beautiful to look at. Even existing buildings can be suitably modified to serve as repositories for libraries, museums, archives and documentation centres *i.e.*, where paper based materials are stored, used and displayed.

Security

It may be stressed that the needs of libraries, museums and archives or for that matter documentation centres, are special. These should be kept in view when a new building is being designed. Besides providing protection against the agents of decay, as already indicated, the building should have security arrangements for fire prevention and fire detection* and also fire fighting facilities. In addition provision for closed circuit scanning devices should also be made.

For fire fighting carbon-dioxides and chlorinated hydrocarbons are commonly used. The best of course at the present moment are halogen based fire extinguishers. Nevertheless every building must have a water storage tanks, underground or otherwise, for use in fighting any configuration.

Environment

Environmental control can be achieved by air-conditioning having provision for washing of intake air. Where air-conditioning is not possible environmental climate can be simulated by use of air-circulation, use of silica-gel, curtains and by taking other precautions, besides incorporation of architectural features.

Curative preservation—Acidity

Acidity can be controlled by deacidification or neutralization techniques. The one that has proved good as a preventive preservation (conservation) technique is the use of ammonia (Kathpalia) process. It is a simple and cheap technique and has proved useful as a mass deacidification technique for conservation under controlled conditions of relative humidity and temperature. It has also been successfully used as a deacidification technique prior to restoration.

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*Smoke detectors are the best.

There are 19 processes of deacidification of materials on paper at the present moment. The ones commonly used besides the ammonia deacidification (Kathpalia) process are the use of (a) calcium hydroxide and calcium bicarbonate solutions (Barrow's two shot method) ; (b) a mixture of calcium bicarbonate and magnesium bicarbonate solutions (Barrow) ; (c) magnesium bicarbonate solution (Gear ; Barrow) ; (d) magnesium hydroxide solution (Wilson) ; (e) barium hydroxide (Baynes-cope) and (f) magnesium methoxide (Smith process). Two other methods which some are bound to advocate are diethylzinc (U. S. Library of Congress) and merpholine (Barrow's Laboratory—now extinct). However, these are suspect specially for archival documents.

Flood damage

Flood damaged and fire charred paper based materials pose special problems. These require specialized treatment by scientifically trained persons. Such damaged material, therefore, should not be subjected to any treatment by untrained persons. Treatment involves use of various techniques like freeze drying, vacuum dehydration, mass drying in ovens, such as tobaco burns used in salvaging flood damaged documents in Florence in 1966, under controlled conditions involving careful handling and cleaning processes.

Restoration techniques

Once a document has been damaged or has become brittle or breaks up on handling or has been eaten in portions by insects or desized as a result of fungi action, the only way to preserve it is to resort to restoration after deacidification as mentioned earlier.

There are a number of techniques, traditional as well as modern, for restoring paper based materials. But the best is the one called Solvent Lamination process also called the Indian process of lamination. The use of this process, developed at the National Archives of India, has been modified, extensively used and advocated by Kathpalia who has been responsible for its use and adaption by some 53 institutions in 32 countries of the world. In most of these institutions Kathpalia has trained personnel and set up facilities for scientific preservation. Since the process is cheap, simple and efficient it is being adopted by more and more countries. Latest to join is Bangladesh where the author has recently given a course on this.

Because of the shortage of specially formulated cellulose acetate film (U. S. National Bureau of Standards) the machine lamination process, either Barrow's or flat-bed lamination, has given way to encapsulation and leaf-casting techniques. Encapsulation poses a number of problems and is not a panacea for restoration problems as was believed by a few specialists. It has created certain problems of its own. A few conservation experts including the author have pointed out the drawbacks that are now being voiced in U. S. A. by even those who were its ardent advocates. One of these is auto-deterioration.

Leaf-casting though costly at present is certainly a better technique and its use is bound to increase with time. A number of machines have been developed since the first one *i.e.*, Recurator in Bulgaria (Mr. Alkalay), such as, in Israel, Austria, Spain (Vinivector) and U. S. A. where bigger models of Recurator type of leaf-casting machines have been fabricated. More and more countries in Enrope are adopting it.

The author would request the conservators to use polyethylene/ester film for the purpose of machine lamination and could suggest extensive experimentation to choose the right type of such film being manufactured in developing or emerging countries. Normally this work should have been taken up the National Research Laboratory for Conservation of Cultural Property set up by the Government of India at the recommendation of a Committee of which the author was a member. But..........?

Some conservators are turning to traditional processes of repair by using the trusted adhesives based upon flour paste or using the newer synthetic ones, such as involving the use of methyl cellulose, poly-vinyl alcohol and acetate respectively formulations, and sodium salt of carboxy methyl cellulose (CMC) amongst others. Here caution is necessary as these are suspects. Adhesives based on flour paste or rice starch mixed with P.V.A. emulsion are proving useful than the others.

Training

Preventive preservation (conservation) and curative preservation (restoration) involve the use of different steps and different techniques. These are as varied as the causes of deterioration of paper materials. Conservation specialists should not only have knowledge of the various processes involved but should also have knowledge of the various materials used for the creation of paper based materials and also of the materials likely to be used for preservation *i.e.*, both preventive preservation (conservation) and curative preservation (restoration), and their behaviour, over a period of time and effect. Such knowledge requires specialized training, the need for which must be recognized and stressed by the respective institutions and the concerned authorities. Already a number of priceless documents and other materials have been lost as a result of wrong treatment by untrained persons.

Scientific training is available in India as a regular course. The present writer has conducted and is conducting specialized training in this field both in India and abroad and has set up a number of conservation centres manned by trained staff. A model curriculum for the purpose has also been suggested by the author with guide-lines. This has been published by UNESCO as a RAMP Study.

9. BIODETERIORATION OF LIBRARY MATERIALS—CAUSES AND CONTROL

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Introduction

Library materials generally comprise books, manuscripts and documents mainly on paper. Palm leaf, birch bark, parchment etc., also form part of library collections dealing with historical material. The care and preservation of these materials not only call for protection from physical and chemical causes of damage but also from deterioration brought about by living organisms because of their organic contents which provide a rich source of nutrition to these organisms. Such deterioration brought about by biological agents is generally referred to as 'biodeterioration'. The problem of biodeterioration is a matter of considerable significance in countries characterised by a tropical humid climate, such as in India because such climatic conditions are very favourable for the growth and multiplication of biological agencies of deterioration.

In the case of books, apart from paper, there are other materials used such as bindings of cardboard, leather or cloth ; glues or resins all of which add to the nutritive content of the books. Because of its cellulosic composition, paper is susceptible to a wide range of biological attack. Some paper is made from wood pulp while others are made from cotton and linen rags, straw, waste paper etc. all of which essentially contain cellulose. Several chemicals are used for bleaching purposes and non-fibrous materials added depending on the type of paper needed. The raw materials and chemicals that go into the composition of paper play a predominant role in the permanence of deterioration of paper.

Biological Agents of Deterioration

The most common biological agents of deterioration of paper are bacteria, fungi and insects. Of these bacteria are of much less importance, though certain species of aerobic bacteria may be involved in the deterioration of paper. They, however, do not play as predominant a role as do fungi or insects.

Fungus attack

In tropical—humid regions of the world, fungi constitute a major threat to the preservation of archival material comprising of paper. More than a hundred varieties of fungi attack paper and paper materials. These fungi have a remarkable cellulose dissolving capacity. It is well known that cellulose provides a satisfactory medium for mould growth. Staining and weakening of paper are the obvious results of fungal activity. The fungi growing on paper usually produce black, brown, yellow and green spots and some may even be colourless. Chromatic alterations on paper on account of fungus growth may depend upon several factors.

Foxing, a characteristic rusty-brown spotted discolouration of paper is said to be associated with fungus growth. Beckwith *et. al.* (1940) observes that foxing or brown-spotting of paper is associated at least partly with fungus growth, but points out that it may also be due to the presence of iron. According to him the organic acids secreted by the fungi in the course of their metabolic processes react with the traces of iron present in paper forming salts that decompose into oxides and hydroxides of iron which are responsible for this restybrown discolouration. Ambler and Finney (1957) have shown that microorganisms are directly responsible for foxing. They develop because of the presence of glue and starch forming hygroscopic areas on paper on which the water soluble products of the decomposition of cellulose accumulate. These assume a brown-red colour in damp surroundings. Opinions are varied on the causes, nature and mechanisms of foxing and the available information is inadequate for making any definite statements in this respect.

Studies conducted by the author on the isolation,' culture and identification of fungi from old paper manuscripts in India showed the presence of the following fungi : *Aspergillus niger, Aspergillus glaucus, Aspergillus flavus, Aspergillus restrictus, Alternaria humicola, Alternaria malvae, Pencillium rubrum, Pencillium funicolosum, Pencillium chrysogenum, Curvularia tetramera, Trichoderma album, Fusarium moniliformae, Cladosporium herbarum.*

Insect attack

The most common insects that attack paper are Silver fish, Book-lice, Cockroaches, Termites, Book-Worm Beetles, Crickets etc. A brief account of their characteristics are given below :

Silver fish (Lepisma saccharina)

The adult is a wingless, silvery or pearly gray, carrot shaped insect, measuring 8 to 10 mm in length. The antennae, cerci, and caudal filaments are as long as the body. The body tapers very markedly from head to tail and is covered with thin scales which give it a silvery shiny appearance. There are two long antennae which are many segmented and three similar appendages at the tail end. The mouth parts are adapted for biting.

The female lays from ten to fifty eggs which under favourable conditions hatch in six to ten days. The young closely resemble the adults. There is no metamorphosis. The larval stage may last from three months to two years depending upon temperature and humidity. Temperatures varying between 16 degrees C. to 24 degrees C. and humidity above 55% are ideal conditions for their development. Characteristic damage : Silver fishes are mostly surface feeders. They show a particular affinity for flour-glue, photographic gelatine, sizes and pastes. They eat away the surface of book-bindings, papers, cards etc. making irregular patches. They generally penetrate the books through the back, which offers them glue and starch. They also destroy wall papers and disfigures miniature paintings and illustrated manuscripts.

Cockroaches

Brown, brownish black or tan coloured, shiny, flat bodied and foul smelling cockroaches are common throughout the world. Several species of them are known to feed on many kinds of materials including book-bindings, leaves of books, magazines, paper boxes and other kinds of paper products. This insect is usually a nuisance in museum stroage where old books, documents and manuscripts are stored. The characteristics of cockroaches are so well known that a description here would only be superfluous. The common Indian species of this insect is *Blatta orientalis*.

Book-lice (Psocoptera)

Annoying, but harmless psocids are those tiny white or grayish white to brown book lice scarcely as long as the width of an ordinary pin head (1 mm to 2.5 mm). These little nuisances do not really damage books, paper and fabrics (silver fish and cockroaches are the real culprits). Psocids are of little importance as far as biodeterioration of paper is concerned, except that their presence in large swarming numbers can be so bad. The author has observed more cases of book lice attack among leather objects, herbaria etc. than among books. Szent Ivany (1968) reports that a species of Psocides, Liposcelis has been observed eating the gelatine of slides of mounted Echinodermata.

There are several kinds of psocids, some with wings and some without. Their body is almost semi-transport and they have long thread like antennae and chewing mouth parts. They go through a gradual metamorphosis. In mild climates 16 to 20 weeks are required to complete the development from egg to adult. Observations in our laboratory showed that the life cycle is completed in 3 to 4 weeks. The occurrence of psocides were also noted on old books and manuscripts on which fungus growth has taken place. Dampness and warmth are the essential requirements for their rapid growth.

Termites

Books and papers are some times attacked by termites. Archival material, if neglected to the extent of being attacked by termites, the results will no doubt be disastrous. The other pests mentioned above do not devastate the collections to such an extent, but termites, given a chance would obliterate paper materials in no time. They have ruined more books than any other group of book-insects.

Book-worms :

Book-worm infection of archival materials has been recorded from many parts of the world. The larvae of some beetles belonging to the family Anobiidae are the true book-worms, though many other insects have been described as book-worms by several authors.

They are several species of them, each of which have a limited geographical distribution. Most of the serious damages to books due to book-worm infections are reported from the tropical regions of the world. The Indian Book-worm Beetle has been identified as *Gastrallus indicus* Reitter. It has been recorded from many parts of India and Burma. Punjab, Dehra Dun and New Delhi in India and Mundalay in Burma were the places from where Gastrallus infection of paper has been recorded in the past (Roonwal and Chatterjee, 1952). During a survey of bio-deterioration of museum materials in India serious infection of this insect in books in libraries and museums has been observed by the author in Hyderabad, Baroda and Dehra Dun, whereas old palm-leaf manuscripts were found attacked in Trivandrum. This indicates the probability that *Gastrallus indicus* has an almost all-India distribution.

The affected books and manuscripts were examined to study the nature of damage caused by the larvae. The larval activity was found to be more predominant within the book-bindings, though this was not revealed by surface examination alone. The bindings were mostly composed of raw, unbleached wood pulp, often possessing a thin layer of leather pasted on to the surface. The adhesives used seemed to be some kind of starch paste. The surface showed a number of small rou holes of 1 to 2 mm. in radius. Inside the binding, underneath the upper layer a large number of tunnels made by the larvae were visible. The larvae make parallel sided tunnels of about 1 to 1.5 mm in width running in all directions, during the course of their feeding activity. These galleries are also found to be filled with irregular shaped feecal pollets. Occasionally, the larvae also tunnel into the pages of the book as revealed by the galleries that run into the leaves. The concentration of the galleries is seen on the edges of the cover as well as in the pages.

The mature larva is about 3 to 4 mm long and has a stout white semi-cylindrical crescent shaped body with the thorax comparatively swollen. There are three pairs of tiny thorasic legs. The adult beetles are small, slender and testaceous brown in colour. The beetles measure about 2 to 3 mm in length and about 1 mm in width. The adult beetle which matures close beneath the book cover or the edges of the pages of the paper emerges from the book by eating up small round holes, usually 1 mm. in diameter which accounts for the large number of holes found on the surface cover of an infected book.

Crickets

The House Cricket, *Acheta domesticus* is also found as a pest of books and manuscripts in India. This black or brown jumping insect is capable of feeing both plant and animal matter indiscriminately. It is known to attack clothing and other household belongings. Considerable damage and destruction brought about to books and manuscripts by this insect was noticed in India.

Control Measures : Fungus Control .

Fungi vary enormously in their response to toxic chemicals. It was found that some types of fungi can tolerate surprisingly high concentrations of certain fungicides which will inhibit other types of fungi at quite low concentrations. Low percentages of thymol and safrol were found to inhibit the growth of Aspergillus Niger, whereas they had little effect on certain penicillium species. Paranitrophenol and Zinc sillico fluoride were found effective against Penicillium but not against Aspergillus. The implications of such variations in tolerance to poisons is that it is essential to use as many test fungi as possible in carrying out laboratory estimations of toxicity. It is obvious that effective use of fungicides calls for an understanding of the identity of the species of fungi so that appropriate use of fungicides could be recommended. The optimum percentages of the fungicides required to be used may also vary depending on the fungi toxicity of the chemical and the fungistaticity of the species in question. While using fungicides on library materials one has to consider the possible chemical effects of the toxic material on the material and any damaging effect has to be avoided. From this point of view, it is always necessary to use the lowest concentration of the chemical that would impart fungicidal property. Studies conducted on the effectiveness of various fungicides gave the following results (Nair, 1974):—

(i) Mercuric chloride and pentachlorophenol are effective at very low concentrations of 0.2 and 0.25 percentages respectively.

(ii) Paranitrophenol is effective only at 3% and above 5%.

(iii) Thymol and sodium fluoride are effective at and above 5%.

(iv) Sodium salicylate and sodium pentachlorophenate are effective at 10% or above.

(v) Other chemicals tested require much higher percentages that are beyond the limits of safety as far as books are concerned.

Insect Control.

The following insecticides are generally found to be effective against the species mentioned :

Silver fishes

Sprays or dusts containing 5% D.D.T., B.H.C. or Pyrethrum. A mixture of equal quantities of Paradichlorobenzene, Benzene and Creosote (P.B.C.) is an effective repellent.

Cockroaches

Sprays or dusts containing 5% D.D.T., B.H.C. or Pyrethrum, Sodium fluoride and Gypsum (1:1) as a poison powder ; P.B.C. as a repellent.

Termites

General termite proofing of buildings, timber work and storage areas.

Book-lice

Pyrethrum sprays ; P.B.C. or Paradichlorobenzene as repellents.

Book-worm Beetles

Exposure to P.B.C. vapour, fumingation with Ethyl or Methyl Bromide or Carbon-di-sulphide.

Care in Use of Biocides.

It has to be kept in mind that libraries are to be used by people. Books are to be handled by readers and therefore use of chemicals can be undertaken only with extreme caution. Most of the treatments specified above should be undertaken after the books are isolated from the reading rooms and stacks. Books which are to be handled by people are best treated with volatile chemicals which do not have any residues after the biocidal action has taken place.

Prevention is always better than cure. Preventive measures to safeguard paper materials from biodeterioration primarily consists of controlling the temperature and humidity in storage areas. Temperature between 20 to 25°C and a relative humidity betwen 40 and 50% are ideal for the preservation of paper. This can be attained by a successful air conditioning system. But when technical or economic considerations make it difficult to have air condtioning, other methods, both physical and chemical should be resorted to.

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10. CONSERVATION OF PAPER, PALM LEAF, BIRCH-BARK, PARCHMENT AND VELLUM MANUSCRIPTS IN LIBRARIES

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Introduction

The collection of library contains of books, journals, reports, pamphlets, clipping and audiovisual material, etc. Furthermore the inclusion of manuscripts to the collection can not be ignored. Still several libraries of national importance in India and outside India are having a good collections of manuscripts on paper, palm-leaf and birch-bark, parchment and vellum. In libraries in India, there are very few number of manuscripts on parchment and vellum while in Europe lot of manuscripts are available on such material.

Most of the readable materials in libraries are of organic nature and prone to decay very fast thus becoming unfit for use, if proper care and handling is not being done. The various other factors (external and internal) also, damage such materials, if not cared properly.

Deterioration

Paper is an easily perishable material. It can be torn, burnt, water damaged, stained and attacked by biological agents. Paper and its products like manuscripts, fermans, calligraphy, lithographs, paintings, drawings, sketches and prints pose with multifarious problems. As far as the conservation and preservation is concerned, paper is basically a cellulosic material and is prepared from wood, cotton, bamboo, rice straw fibres, etc. As we know in its manufacture, it is mixed with different amount of materials like sizing materials—glue, gum, rosin, starch, etc. ; loading materials-clay chalk, talcum, gypsum, etc. ; and bleaching materials—sodium sulphite, bleaching powder, chlorine gas, etc. The presence or absence of these materials has a strong bearing on the resistance of paper towards deteriorating factors. The main deteriorating agents are as under :—

(1) *Physical agents viz.* heat, light, moisture, fire, floods and ravages of war.

(2) *Biological agents* viz. fungi, bacteria, insects and rodents.

(3) *Chemical agents* viz. acidity, pollution, atmospheric gases and dust.

Physical agents :

Light—Natural light and artificial light.

Natural light is composed of various rays :—

(1) Cosmic rays
(2) Gama rays
(3) X-rays
(4) Far Ultra-violet
(5) Near Ultra-violet
(6) Visible light
(7) Infra-red rays.

All rays are not harmful to the cellulose of the paper. Only far ultra-violet rays coming direct from the sun cause rupture of cellulose bond (Photolysis) but of little concern to us because window pan cut out most of these radiations. However, the near ultra-violet rays (3400A° to 5000A°) causes direct destruction of cellulose and bleaches coloured paper, leather and textile. It also accelerates chemical degradation of organic materials, causes brittleness. The cheap paper gets yellowed because of the non-cellulose material such as lignin present in wood and break down into acid compound. Many modern inks, dyes and pigments are also faded or darkened by ultra-violet light.

The ultra-violet rays are also present in artificial light sources which are generally used in museum galleries. The fluorescent tube light possess high percentage of ultra-violet rays while the tungston or incandescent lamps have minimum ultra-violet radiation but heat is given out. The damaging effect can be minimised if the document is displayed in reflected light instead of direct light. Minimum day light should enter the room. Important document can be wrapped in coloured cloth. The wall of the room where the object is displayed if painted with white paint like titanium trioxide or zinc white, the most of the ultra-violet rays will be absorbed. If U.V. filters are provided on the light sources that will cut most of the ultra-violet radiations.

Heat

Temperature beyond 35 to 40°C causes brittleness and dryness in paper. It accelerates the chemical deterioration of paper, leather and textile. The paste, glue, etc. lose their binding strength. Paper gets crockled Palm leaves are desicated by heat and become propile and brittle. The hydrolysis, oxidation and photolysis each are accelerated by heat.

Humidity

High humidity beyond 70 per cent and temperature 27-30°C gives rise the growth of insects and fungi. High humidity also weakens the adhesives and sizing materials, spreading of inks. It also causes stickness in glazed paper-books, manuscripts and paintings.

While in low humidity below 30 per cent for longer period of time, paper loses necessary moisture contains and becomes brittle, the ideal condition to keep the collection safe from this hazard is to maintain 50 to 55 per cent R.H. and 17 to 25°C temperature. The R.H. can be measured by thermohygrograph, wet and dry bulb thermometer, and whirling hygrometer.

Fire, flood and ravages of war

The paper materials suffered total loss due to these factors, if happened. They generally destroy the whole material if not charred them but certainly smoked them, defaced them. The flooded object can be saved to some extent by careful treatment.

To avoid the total loss of the objects, the important documents should be micro-filmed and stored in separate buildings.

Biological agents

Heat alongwith food and moisture is one of the conditions necessary for the growth of insects and moulds. Mould spores are always present in atmosphere. The following insects are the enemies of library materials :—

1. *Cockroaches*

They are brown or black in colour and hide themselves in day time, emerge out at night. They eat away paste and glue from the back of book cover and through the covering cloth of paper and leather bindings.

2. *Silver fish*

It is wingless insect of about half an inch at full maturity. It is pearl grey and have three tail at the end. They are active in night. Silver fish favours damp cool atmosphere and eats away starch, gelatine and glue through book cover from back of the binding. They lay their eggs in dark spaces behind the books in book shelves.

3. *Termites*

Termites are also known as white ants. There are many varieties but earth dwelling and wood forms are well known. They attack from the back of the cupboards and book cases and eat their way through wooden shelves and interior of books. They eat away the cellulose materials.

4. *Book lice or psocids*

They are minutes grey or white insects and favour to live in dark and damp places. They do severe damages to book paper, photo prints by eating glue and starch. They also eat cotton clothes, natural silk, synthetic fibres and leathers.

5. *Book worms*

It includes 160 species. Their larvae and adult beettles are generally seen in dark places. In libraries these beetles lay their eggs on the edges of books. The larvae eat into the books making tunnel in pages through and through.

6. *Moths*

The larvae are white, hairless, dark headed as about half an inch long in size. They eat cloth and leather book cover. They lay their eggs in cracks in floors and walls.

7. *Mudwasps and Bed bugs*

They do not damage the interior of books but stain their cover.

8. *Rodents*

It includes mice, rats, rabbits and squirrels, etc. The female brown rat gives birth to 50 offsprings a year. They eat anything made of paper, leather, vellum and glue, etc.

9. *Mice*

It is also dangerous to paper but to less extent than rats.

Micro-organisms

They grow on organic matter and eat away the sizing materials by which paper become weak and limp. They appear on paper in white, black and green patches. If their colonies are not destroyed they expand enormously and badly stains the paper.

Foxing

Foxing are in brown spots often seen on old paper. It is evident that fungi are at work in the paper. Foxing is a result of chemical action between the iron impurities (Iron hydroxide and Iron oxide) in paper and the organic acid released by fungi. Such type of stains can be bleached by weak solution of hydrogen peroxide or potassium permanganate solution followed by weak oxalic acid solution.

Chemical agents

Different ways and sources of acidity in paper materials.

(a) *Inherent during* the process of paper manufacture :

- (i) Digestion
- (ii) Chlorination
- (iii) Bleaching
- (iv) Sizing (alum and rosin)

(b) *Acquired by*

- (i) Absorption of sulphur dioxide and carbon dioxide through climate.
- (ii) Inks and pigments (writing, illustration, printing).
- (iii) Contact materials such as covers, repair material, paste, etc.

(c) *Break down* of added materials such as Rosin :

The presence of acidity in paper can be tested with blue litmus paper which turns red to brown. It is also measured with pH meter which gives the range of pH. Higher the pH, lower will be the acidity and *vice versa.* Paper is neutral at 6.0 to 7 pH. Higher alkalinity is also harmful. This can be tested with red litmus which turn red to blue.

The presence of acidity in paper from whatever sources, produces brittleness and breaks down the cellulose chain.

Like other valuable museum materials which are to be preserved for long period of time, the paper manuscripts also need great care in storing and handling under ideal condition of storage and display. Paper prove more lasting than all other materials. It survives best in clean and cool atmosphere, free from dust and products of combustion. Paper objects should be displayed only in moderate climatic conditions while in storage the paper should not be kept loose in the dockets and should be kept well pressed.

Faulty approaches by human beings :

Lastly a great deal of deterioration to the paper objects is also caused directly or indirectly by human being. These factors become quite alarming as they are the result of faulty approaches and use of cheap materials *e.g.*—cellotape for mending tears, cheap card board and iron nails etc. used in framing in shops or by layman. It has been observed that more harm has been done and is still being done to art on paper in framer's workshops, than from all other causes put together. In these workshops cheap materials are used to save a few pennies and not going in for the scientifically recommended material. We are concerned with the scientific investigation of the materials to be used for the preservation of art and antiques. All the materials produced by the manufacturing are not of standard quality. The successful restoration depends upon the good quality of material, practice and experience of the restorer and its proper application.

Control of Deterioration :

(1) Preventive measures ;

(2) Restoration after damage has occurred.

Preventive measures :

Preventive measure is helpful to create an environment in which the enemies of paper and archival material cannot exist. This include proper condition of storage, prevention of air stagnation, control of temperature and humidity, removal of aerosols and noxious gases from polluted air, good house keeping, control of sunlight and scientific lighting, improved storage and care in handling, etc.

Environment control :

The room where the collection is stored should not be in direct hit of extreme weather of heat or cold, moisture or dryness. This can be achieved by following methods :

(i) Air-conditioning :

The most practical way to control temperature and humidity are to clean air by central air conditioning. In this case suspended aerosols are screened from air by filters. Sulphur dioxide can be partially removed from air by frequent recirculating through activated charcoal filters. The most effective use in Washington and National Gallery in London is to pass incoming air through water spray. Pure water will remove half the gas while alkaline water spray (pH 8.5 to 9.00) will remove all the gases. The humidity and temperature should be maintained at 55 to 60% and temperature 21 to 25°C. But it is very costly affair and our museums are not in a position to go for it. In the absence of air-conditioning less costly means to be adopted.

(ii) Other methods :

During the dry summer months to control humility, khas, curtains, cleaning of floor by wet duster, water coolers are used. If the humidity is high beyond 70%, this should be brought down to 55% by dehumidification. If the object is placed in a show case, silicagel, a chemical absorbs moisture and gives it of on heating, be recommended, or anhydrous calcium chloride can be placed to absorb moisture, or hot air fan can be used. A very practical suggestion is the incorporation of hydroscopic material like carpet, curtain, furniture, wood cupboards, etc. The humidity and temperature can be measured by Thermohygrograph, wet and dry bulb thermometer or by humidity indicating paper which change its colours.

Light control :

The far ultra-violet rays (below 4000 A) coming from sun cause direct breakdown of the cellulose bonds (photolysis). This can be prevented by the glass at the window. Infra-red has no effect. However the near ultra-violet rays are low visible light radiation 3400A-5000A cause indirect destruction of cellulose which blackens coloured paper, leathers and textiles. This can be prevented by plastic screening which reduces the intensity of sunlight. Secondly, white paint (Titanium dioxide pigment) on a roof or wall will further absorb near ultra-violet radiation. This will remove about 90% of near ultra-violet radiation. The minimum daylight should enter the room or important document can be wrapped in coloured cloth.

The damaging radiation in daylight is ten times as great as in incandescent light and about four times as great as in fluorescent light. Fluorescent lights should be filtered. Incandescent light need not be. Display cases should be protected by plastic ultra-violet filter sheets.

Control of bio-deterioration :

1. Control of high humidity as discussed above.

2. If the optimum conditions required for the growth of micro-organisms and insects are eliminated, the growth of fungi can be minimised. The insect control consist of keeping the insects out. Insects need not be a problem if good house keeping and sanitation are observed. The wooden almirah where records are kept should not touch the wall. Books always be kept loose in the shelf so that air can pass.

3. Use of insecticides and fungicides :

The dwelling termites that gain access from the tunnels, cracks or crevices of floor, can be killed by spraying with a mixture of dialdrin in water or shell tox, etc. The wood-shelf can be sprayed with creosote or 5% D. D. T. in kerosene.

Cockroaches, silver fish, etc. can be controlled by spraying the walls, wood works, floors, ceiling with 5% D.D.T. The dusting powder (mixture of pyrethrum flowers and sodium fluoride) can be sprinkled under the racks. Beetle or book worm affected paper can be exposed to PBC vapour or fumigated with ethyl or methyl bromide.

To keep the insects away, the following repellant can be used in an air tight chamber or can be kept in steel almirah.

4. Repellants :

Naphthalene balls, thymol, camphor, PDB (Para di-chloro-benzene).

Following are the common insecticides and fungicides :

Insecticides :

Coal tar, Creosote, Gammexine powder.

D.D.T.

1% Mercuric Chloride in water (for wooden panel back).

2-3% Penta-chloro-phenol in Alcohol.

2% Aldrin, Dialdrin in water.

Sodium arsenite solution : 1 part in 9 parts of benzene.

P.D.B. (Para di-chloro-benzene-50 gm.).

Benzene-50C.C.
Creosote-50C.C. } effective repellant.

5. *Fungicides :*

Fungicides are used in vapour form or solution. The more important vapour form of fungicide is thymol. Slight heat by an electric bulb must be applied to thymol in air tight chamber to evaporate. The penta-chloro-phenol or ortho-phenyl-phenol in alcohol can also be used, either by brush or by spraying.

If a manuscript is soaked with water by accident, immediate action must be taken to dry it. Otherwise fungus is bound to grow on it. The wet manuscript should be placed in an open space and a slow current of air passed over it until it is dry.

Sterilization of the atmosphere of the storage room by spraying 10% thymol in alcohol has been recommended to keep a check on the growth of spores present in store room, where humidity cannot be brought lower than 75% during monsoons. After spray the room is closed for 24 hours.

Control of acid deterioration

The permanence of paper is more important than durability. The acid deterioration of paper must be restrained preferably by control of manufacturing process and on the premises of libraries for those books being embrittled in storage. Deacidification is probably the most important process for preservation. There are different processes of deacidification to be done by technicians. As the acidity has tendency to migrate from page to page at a very slow rate, the direct contact of manuscript with acidic paper or boards is injurious. Therefore the sheet used for covering illustrations in manuscripts or use for repair of manuscripts should be free from acidity. The manuscripts should not be covered or wrapped in acidic paper. Very important document if at all to be kept in industrial towns or places where lot of So_2 is produced, can be kept by wrapping in chlorophenyl impregnated tissue paper.

Care in handling and storage :

The records should loosely be packed on the shelves to enable free air circulation and preventing pocket of high humidity. Periodic inspection of storage will help in eliminating the possiblilties of insect attack. Regular dusting with electric vacuum cleaner will remove dust completely. Records should be handled with great care. All efforts for proper preservation and storage will be in vain if care is not observed in handling. Paper should be lightly lifted with both hands. Document should not be touched with unclean, perspiring or wet hands. Neglect of few simple precautions result in irrepairable loss. Fire, accidents, smoking should strictly be prohibited in record room and any open fire should be forbidden. No chemicals should be stored in record room. Food beverages should not be allowed inside the storage area. Strict cleanliness should be observed. Necessary fire fighting equipments of gas type should always be at hand. Movement of records or books is facilitated with the use of trolleys. Windows of the room that open in the space outside or in the courtyard in the interior should be fitted with metal grills and net of expanded wire metal to ensure that they remove splashing of rain water.

Restoration and Treatment of Paper Documents:

Preservation of documents constitutes two aspects, one conservation and the other restoration. To put simply, conservation is akin to taking preventive steps for protection and against diseases and constitutes steps like good house keeping and preventive action against agents of deterioration of archives materials, such as :

(a) Biological agents like fungi, bacteria, insects and rodents.
(b) physical agents, viz. heat, light moisture fire, floods and ravages of war, and
(c) chemical agents, i.e. acidity, pollution, atmospheric gases and dust.

Restoration, on the other hand is akin to surgey, i.e. taking corrective measures for strenthening weakened or brittle documents. Once deterioration has set in and paper, on which most of our archives are, has become brittle, or damaged by insects, fungi, acidic impurities or by any other cause or causes, like acts of man or natural calamities, restoration is the only way to impart strength to make it useable and serviceable.

In both these fields, i.e. conservation and restoration the tempo of work and research has increased during the last decade or so. As a result, a number of techniques, materials and equipments have flooded the market making it difficult for institutions in developing countries and also to some extent in developed countries to choose on the right type and best suited to their needs.

Principal of repair:

(1) **Examination of the nature of the material;**
(2) **Extent of damage;**

(3) Types of ink ;
(4) Acidity ;
(5) Numbering.

Rules of Repair :

(1) The originality must be maintained.
(2) The nature and extent of the repair should be evident.
(3) The writing should not be married or defaced in any way.
(4) The process applied should be reversible.
(5) Methods used for repair should be durable.
(6) Maximum re-inforcement at minimum cost.

Preservation :

Treatment which makes an object last longer is called preservation. Preservation stops a paintings going to peg, but it does not improve the surface appearance.

Restoration :

It is a surgical operation comprising, in particular, the elimination of later additions and their replacement by better material or reconstitution of the original state.

Conservation :

It is deprived operation aimed before every thing prolonging life of an object while preventing for shorter or longer duration its accidental or natural deterioration.

Treatment :

(1) Documentation :

(a) Photography : Photography is an aid in conservation science. Minute details are recorded. U. V. photography and infra-red photography records details which are not visible to eyes. Writing which were made illegible by chemical bleach or mechanical erasure or by application of ink can be studied.

(b) Preparation of history sheet : Aim of this is to collect information of the object. When it is received for treatment, the examiner should record information, how the object appear to his eyes. In this case the physical conditions of the object, missing portion if any, damages are recorded. In the history sheet, report of chemical analysis is also recorded.

(2) *Fumigation :*

The process of disinfection involving the use of an insecticide or fungicide in gaseous form is called fumigation :

(i) Fumigation in air tight chamber,
(ii) Fumigation under vacuum.

Following fumigants are used :

(i) Hydrocyanic Acid gas, which is very dangerous.
(ii) Carbon disulphide.
(iii) Ethylene oxide plus carbon dioxide-Carboxide—1:9 (under vacuum fumigation),
(iv) Ethylene dicholoride plus carbon tetrachloride—3:1 (know as killopetra),
(v) ethyene oxide,
(vi) Methyl bromide,
(vii) PDCB.
(viii) Thymol, Camphor or Para dichlorobenzene.

For immediate action 1% thymol or 1% pentachlorophenol in alcohol can be sprayed if the colour of the object is not affected.

Cleaning :

The dust which has accumulated should be removed by soft brushes from the junction of leaves. If possible vacuum cleaning or cleaning under air pressure be adopted depending upon the condition of the objects.

Testing of acidity :

Acidity in the paper can be tested with moist blue litmus paper, in contact with the object if blue litmus paper turns brown, then acility is present. If does not change, no acidity.

pH meter :

pH is defined as the concentration of hydrogen and hydroxyl ion. Higher the pH lower the acidity, lower the pH higher the acidity. Paper is neutral at 6.7-6.9 pH while brittle at 4 pH.

Examination of ink :

Identification of ink is an important aspect of criminology and is the subject of considerable research. Test the solubility of ink by placing a drop of water. Soak it on filter paper. Test the solubility in alcohol. The traces of colour are evidence of solubility.

Iron gall ink :

1. Put a drop of 5% Acetic acid on the letters and pick it up after 5 minutes with blotter.
2. Put a drop of Potassium ferrocyanide (1%) on the blotter.
3. Blue colour on the blotter indicate the presence of iron or put a drop of potassium sulphocyanide (1%) on the wet blotter.

   Re colour indicates the presence of iron, or put a drop of 4% sodium hydroxide solution on writing and pick it up with a blotter.

   If dark brown colour appears—iron is present.

Carbon black ink :

The most ancient ink is the carbon ink, prepared from lamp black, the binding medium being oil, gum or glue, etc. Carbon ink is extremely stable and cannot be removed from documents by the action of chemical bleaches but the modern carbon ink supplied in liquid form utilises carbon black rather than soot as the source of amorphous carbon while the hide glue is replaced by a solution of shellac in borax.

Fixing of ink :

If the ink is susceptible to moisture, the ink should be fixed prior to acquous treatment. For this 2% PVA in toluene is applied on the letters with fine brush. This process can be repeated till the ink does not show the tendency of staining the moist cotton.

A coating of amyl acetate (50%), acetone (50%) with celluloid film (5 gm.) can also be applied with soft brush.

Deacidification :

The permanence of book is more important than durability. The acid deterioration of paper must be restrained preferably by control of mgf process and also on the premises of libraries for those books being embrittled in storage. Acids mostly H_2So_4 break the links of the cellulose polymer chain reducing the strength of paper fibre. Strongly alkaline paper is also dangerous because hydrolysis takes place in presence of (OH) ions as well as acids.

Deacidification is probably the most important process for preservation of paper—but it does not decrease the probability of biological attacks because some fungi thrive in alkaline conditions. Nor does deacidification prevent oxidative decay or photochemical reaction and it will not strengthen paper already embrittled by acid hydrolysis. On the other hand deacidification does arrest the deterioration and embrittlement of paper by introducing strong base to form neutral salts with the sulphuric acid. The excess neutraliser must also be easily convertible to neutral substance so that paper will not be subjected to subsequent alkaline hydrolysis. The same neutral salt will act as buffering agent.

Resizing :

If the paper has become limp or porous due to the loss of sizing material, the same can be resized with sizing materials, e.g. soluble nylon, starch, gelatine, etc.

Removal of stains :

The removal of stains depends upon the nature of stains. The following solvents have been successful in removing the stains listed opposite to them :

Stains	*Solvents*
Adhesive tapes	Benzene, carbon tetra chloride
Glue	Warm water
Lacquer	Acetone
Oil, greese and tar	Benzene, pyridine, trichloroethylene
Tea and coffee	Potassium perborate
Mildew	Ethyl alcohol
Mud	water, Ammonia
Rust stains	3% oxalic acid
Ink stains	Citric acid, oxalic acid.

Mounting and lamination of highly fragile document :

If the paper document has become weak and cannot be handled with hand, the same can be strengthened by lamination process. There are different methods of lamination and mounting—(i) Hand lamination and (ii) Machine lamination out of which hand lamination is best.

Lamination :

(1) *Morane Process.*—Under heat and pressure with cellulose diacetate film—gloss finish and cellulose triacetate—Matt finish at 80°C—

(2) *Mipofolic Process.*—It is used in Germany but not suitable for document. In this case PVC film used with adhesive at room temperature for maps, etc.

(3) *Genotherm Process.*—Polyvinyl chloride film used in this process at 70°C but as PVC is not good for document, it is used for news papers, etc.

(4) *Hennecke Process.*—Based on cellulose acetate film at 80°C for 20 seconds under press of 30 kg/cm.

(5) *Postlip Duplies Process*.—By langwell at Public Record Office, London. In this case alpha cellulose tissue if 15 g. per meter is impregnated with PVA and acid neutralising agent magnesium acetate. This tissue is applied at 85°C. Smith has worked on it but document treated with magnesium acetate darkens after lamination. This effect is intensified in tropical countries.

(6) *Dispro Process.*—At British Museum, London. Dispro-tissue backed with acrylic resins adhesive comes out in cold under pressure in a machine known as Ronofeder.

(7) *Zagreb.*—Polythene film at 100-115°C under pressure of 4.5 kg./ Cm_2. It eliminates the higher temperature and longer pressure and cost of equipment.

Care in handling and storage :

The records should loosely be packed on the shelves to enables free air circulation and preventing pocket of high humidity. Periodic inspection of storage will help in eliminating the possibilities of insect attack. Regular dusting or cleaning with electric vacuum cleaner will remove dust completely. Records should be handled with great care. All efforts for proper preservation and storage will be in vain if care is not observed in handling. Paper should be lightly lifted with both hands. Document should not be touched with unclean, perspiring, oily or wet hands. Neglect of few simple precautions result in irreperable loss. Smoking should strictly be prohibited in record room and any open fire should be forbidden. No chemicals should be stored in record room. Eatables should not be allowed inside the storage area. Strict cleanliness should be observed. Necessary fire fighting equipments of gas type only should always be at hand. Because the wet type of fire extinguishers, though very useful stain printing materials which may even have the bleaching effect. Movement of records or books is facilitated with the use of trolleys. Windows of the room that open in the space outside or in the courtyard in the interior should be fitted with metal grills and net of expanded wire metal to ensure that they minimise the splashing force of rain water.

Manuscripts on palm leaf :

Basically there are two types of palm leaves which have been used as writing supports, SRITALA and TALA. Both have different names in different parts of India and indeed, in different countries.

SRITALA (CIRYPYA UMRACAULIFERA), also known as TALIPAT, TALIPOT or KARIMPANA. This leaf is mostly found in south India, specially in Malabar. They are small, fine soft & flexible leaves. These leaves can be incised or written with brush or pen. They are often found with painted illuminations. The earliest manuscripts are mostly on this variety.

TALA (*BRORASSUS FLABILLIFER*), also known as PALMYRA or THALIVOIA grows all over India. This type of leaf is large, thick, less flexible and non-absorbent, but suitable for incised writting. Lamp black (Carbon black) with binding medium is used for the ink.

Freshly cut leaves from a tree are not suitable for writing purposes. The leaves are first seasoned by several methods. After that the leaves are trimmed and polished. The scriber then either writes on them or incises the text on them with a metallc stylus. If the leaf is incised, it needs inking. To bind the leaves together holes are punched in the centre of the leaves and cords are passed. The whole leaves are pressed between two wooden pieces, sometimes decorated by carvings or paintings.

Deterioration and treatment :

With passing of time, several defects develope in palm leaves. They are as follows :

1. The palm leaf is easily damaged by insects, making holes through the leaves and breaking them into pieces. Fungus are rarely noticed in palm leaf.
2. *Discolouration.*—caves become brown or black and get stained.
3. *Loss of flexibility.*—It is due to loss of natural oil. Due to this loss palm leaf become dry and brittle. Old leaves break into pieces.
4. *Splitting of layers.*—In Sritala variety, the surface layer of one leaf gets stuck to the adjoining leaf layer. This is due to the poor adhesion between various layers. As a result of mis-handling or for other reasons, the incised text may be rubbed off or become indistinct, sticking of leaves together are very common defect in palm leaf.

First record the damage to the manuscripts by photography or by recording the damages on history sheet. Secondly, the manuscripts must be examined and plan for necessary treatment should be chalked out.

Fumigation :

The insect affected leaves are first fumigated in a air tight chamber with para-di-chloro benzene and thymol crystal in the ratio of 1:1. The fumes will help in repell as well as kill the insects and microorganisms.

Cleaning :

The incised text and the surface written text are cleaned by different methods. The incised text should first be cleaned with fine brush to remove the dust at the initial stage and then with a mixture of alcohol and distilled water in the ratio of 3 :1. This is applied with a swab of muslin cloth following the line of grains. This process is applied on both sides of the leaves. Leaves are kept for slow drying between sheets of blotting papers.

The surface written text can be cleaned with 1:1:1 trichloroethane (genklene) which can be applied with a swab of muslin over the leaves following the line of grains. Care must be taken while applying trichloroethane that the ink may not be obliterated.

The stuck up leaves can easily be separated if the lumps of such leave are kept in high humidity chamber. Then the leaves be separated mechanically. Separation can also be done placing the bundle of manuscript in hot water containing 5-10 c.c. glycerine or by immersion the bundle in hot liquid paraffin at (70-80°C). The separated leaves can be cleaned with acetone to remove the paraffin-wax.

Reinking of the leaf can be done by the application of carbon black mixed with an oil, such as citronella or camphor oil. The mixture is applied over the entire leaf and left over night. The surface of leaf is then cleaned with alcohol.

To impart flexibility the natural oil should be replaced with 5% sol. of camphor oil in methanol. This can be applied on both side of the leaf. Mr. Marsh has quoted the use of 2% PEG-100 in water for flexibility.

Repair :

To repair the broken leaves, one side written leaf can be supported with another palm leaf inter leaving a paper in between with adhesive, such as PVA emulsion.

Both side written leaf can be repaired by using chiffon coated with acrylic emulsion under heat at 70°C in an electric mounting press. The assembly is protected with silicon paper while putting in the press. Small holes are repaired by plane palm leaf or a paper called wood veneer, using 5% polyvinyl acetate solution in toluene.

Mr. Marsh from India Record Office, London and Mr. Crowley of British Museum, London have used paper in place of chiffon. The result by using chiffon is quite satisfactory. Palm leaves are like any other material of historic interest and need to be stored, clean and stable. The storage condition are the same as that for paper 55% to 60% R.H. and temperature 20°C to 25°C.

Preventive conservation :

1. Humidity and temperature should be maintained between 55% to 60% and temperature 20°C to 25°C.
2. The manuscript should be wrapped in thick coloured cloth preferably in the insecticide coated cloth and stored in wooden almirah.

3. In place of fumigation, Neem leaves (Margosa leaf) or ghora barch (Acarous calamous) should be placed on and below the palm leaf manuscripts which are tied in bundles. These leaves keep the insects away.

Manuscripts on birch-bark :

In India before the advent of paper sometimes in the 12th Century, birchbark Bhoj-patra) was used for writing purposes. The bark sheets consists of a number of thin layers. The inner layer is used for writing purpose. It was slowly dried and their oil was applied over it and was polished. To make it for writing the leaves are cut into proper size. Manuscripts on birch-bark are mostly written in carbon inks containing glue as a binding medium.

Deterioration :

Birch-bark is composed of several layers, these layers are joined together with a natural gum and knots and streaks which are composite parts of the bark. In course of time, possibly with the effect of moisture, the individual layers of the bark start separate one from each other. The birch-bark weakens considerably with time and becomes hard and brittle. The sheets may stuck up together due to moisture and high humidity.

Treatment :

Sheets which have stuck up together may be separated by placing them for humidification or exposing them to steam. When they have become sufficiently moist, each sheet is separated carefully. For cleaning a mixture of trichloroethane with alcohol and glycerine is found suitable, but care must be exercised in its use and handling.

Brittle birch-bark is often conserved and repaired either with chiffon using flourpaste or by hot lamination with cellulose acetate foil and tissue paper. In case two layers have separated due to loss of natural gum such sheet can be laminated by putting a sheet of tissue paper between the two loose layers of the leaf using CMC and PVA emulsions in the ratio of 2 :1. It is a difficult task and can be done only by an expert. The separated sheet can also be laminated between the adhesive coated chiffon under heat at 70°C for 2 minutes in an electric press by putting the assembly between two silicon paper sheets. The mounted sheets can be put apart from one another by keeping wax paper sheet in between.

Manuscripts on vellum and parchment :

Parchment is prepared from wet, unhaired and limed skin, simply by drying at room temperature under tension most commonly on a wooden frame known as a stretching frame. Generally the skin of small animals such as calves, sheep and goats are preferred. It can also be made from skins and larger hides specially for writing and book binding material. Large number of parchment manuscripts are available in Europe, Middle East and all over Asia. In India a few manuscripts are available.

Vellum is made from the inner portion of the skin which is very thin and transparent, vellum is not much used for writing purpose but only used for small line sketch and painting, etc.

Documents on parchment is essentially written in blue black ink based on iron tannin complexes. The gum arabic and black pigment (Lamp black) is also added to achieve shade and adhesion. In the earliest manuscript only lamp black ink was used by China. Tannin based writing if faded can be intensified.

Manuscripts on parchment are affected much more by humidity, heat and light, fold and wrinkles.

Cleaning of parchment :

For cleaning parchment manuscripts following methods were used. The simple method recommended by Plender-leith and Langwell is to rub the parchment gently with a pad of moistened cotton wool and then dried as quickly possible. Some restorers have used the moistened wheat bread and rubbing it between the hands which is pressed on the sheet and rolled over its surface.

Fresh onion jouice is also used in place of water for cleaning parchment leaves.

Cow milk which has been boiled and cooled is also used. It not only cleans the surface but also introduces emulsified fat into the sheet. Cleaning is also effective with eraser of soft roll.

Repair :

The repair of parchment documents requires great skill. Holes and tears are repaired by patching or by reinforcement, parchment glue or size is used as an adhesive for repair and strengthening. The glue is made from fish bone or parchment clippings—one part by weight is droped in two part by weight of cold water and boiled till three part are evaporate to one. For minor repairs, gelatin containing a drop of glacial acetic acid of paste can also be used. Besides patching large holes and tears parchment glue is used for sealing pin-point holes in parchment sheets.

The best means of ensuring the long term conservation of parchment or leather binding in Libraries and Museum are as follows :

1. Exposure to strong sunlight and especially close contact with electric lights should be avoided.
2. Relative humidity should be maintained between 55% to 60%.

11. PRESERVATION OF PAPER PAINTINGS

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Introduction :.

Paper paintings are a class by themselves, because they are different, in structure and concept, to paper documents and printed books. After the advent of paper, the artist preferred this material to other materials like the birchbark or the palmleaf. As a result, there are vast collections of paper paintings of different regions and periods, in museums and libraries of our country. Almost every museum and library having manuscripts in its collections possess paintings on paper. These paintings are mostly of a small size and, therefore, they came to be termed as *'miniature-paintings'*, although there are large paintings also.

The paper on which the painting was done was manufactured in various sizes and in various thicknesses. Quite often, small paper sheets were joined together to get a larger format of paper. Paintings were done either only on one side or sometimes on both sides of the paper. Quite often, on one side was the painting and on the other the text. The board of the painting was obtained by pasting several sheets of paper together.

Due to the variations in the structure of a painting, its conservation is a complex phenomenon. In this note, it is therefore, proposed to deal first of all with the anatomy of the painting, and the composition of various materials, and then the process of deterioration and finally an outline of conservation techniques. In a limited space it is not possible to bring out all the information and for details the reader may consult the book "Conservation of Manuscripts and Paintings in South-East Asia : O. P. Agrawal".

Anatomy of a Paper Painting :

A painting is obtained by laying a layer of a paint on a rigid *support*. In the case of paper paintings the support is obviously a sheet of paper. The paper in ancient times was made of cotton rags, discarded fishing nets, jute, bamboo and some other fibres. Recent studies at the NRLC indicate that *'sunn'* had also been used for making paper. After the paper sheets are formed, starch paste was applied on the surface as 'sizing'.

The painting was done either on a single sheet of paper or on a thicker board prepared by pasting several sheets of paper together. Sometimes two, three or four sheets were pasted in such a manner. The prepared board was known as *'wasli'*. Sometimes the painting was done on a separate sheet of paper, which was then pasted over the *wasli*.

The paper or the *wasli* was thoroughly burnished with an agate stone before the painting was started.

Quite often, a thin white layer of an inert material was applied on the surface of the paint to act as a *priming*. The purpose of this layer was to smoothen the paper. On this *priming*, an outline either by free hand or by stencils was drawn. Pigments or paints were then filled in according to the need of the design. Burnishing was an important step after every stage of painting.

Varnish as a final protective coating, so very common for oil painting, was seldom, if ever, used for miniature paintings.

With this basic form of paper painting one can find several variations. For instance, there may be several coats of priming, or of the paint. Some artists have used thin coats of glazes over the paint to bring about special effects.

The paint is prepared by mixing pigments with a binding medium, like gum, glue, egg-yolk or tamarind-seed-paste. Glue was by far the most important and the most popular binding medium used in Indian miniature-paintings.

The most common pigments found in paper paintings are :

(i) Red : red ochre, vermilion, lead red, lac dye.
(ii) Yellow : yellow ochre, orpiment, *gaugoli.*
(iii) Blue : ultramarine, indigo.
(iv) Green : mixture of yellow and blue, malachite, terreverte, verdigris.
(v) White : burnt conch shell powder, chalk, gypsum, kaolin.
(vi) Black : lamp black.
(vii) Metals : gold leaf or powder ; silver leaf or powder.

To get shades pigments were mixed with each other.

Deterioration of Painting :

Paper painting, like any other paper document also deteriorates. What is important in a painting is the fact that in order to retain the form of the painting, the paper and the paint must adhere well to each other. If for any reason, the paint separates from the paper, it will no more be a painting, it will turn only to a piece of paper.

Furthermore, several techniques of restoration applicable to paper documents are not applicable to paper paintings because the paint is rather

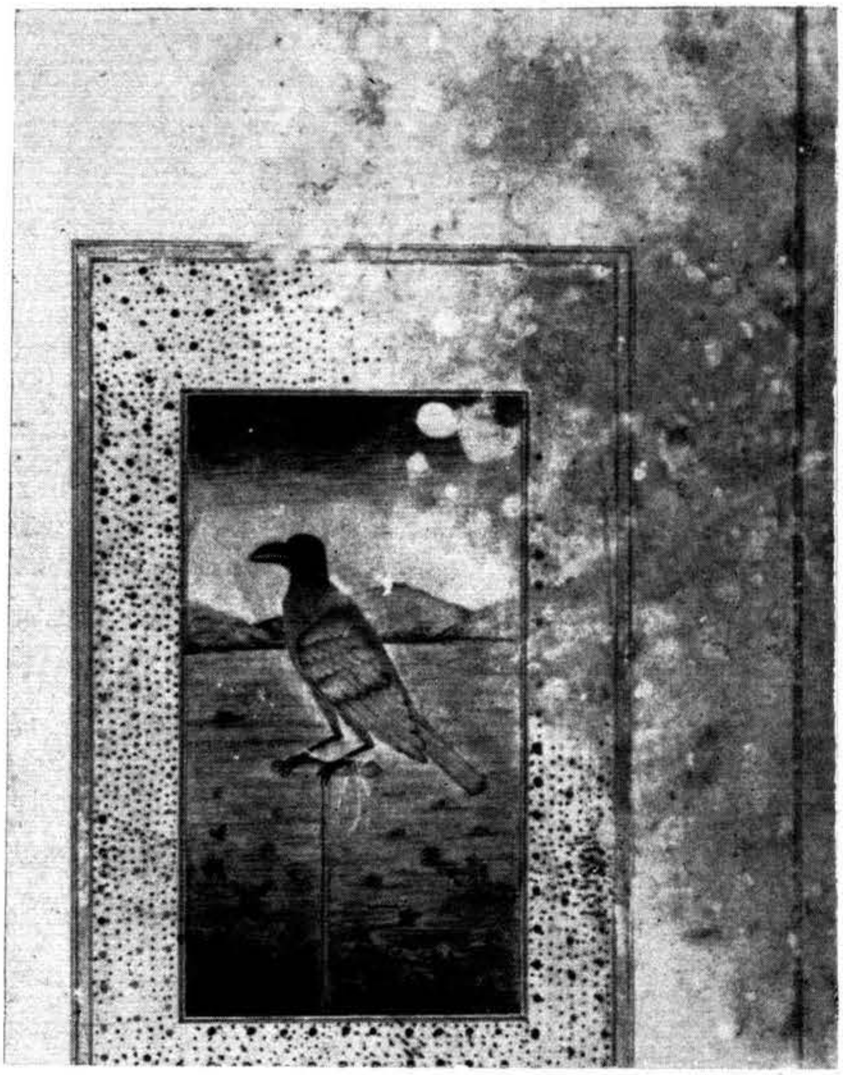

Figure 1. A miniature painting affected by fungi.

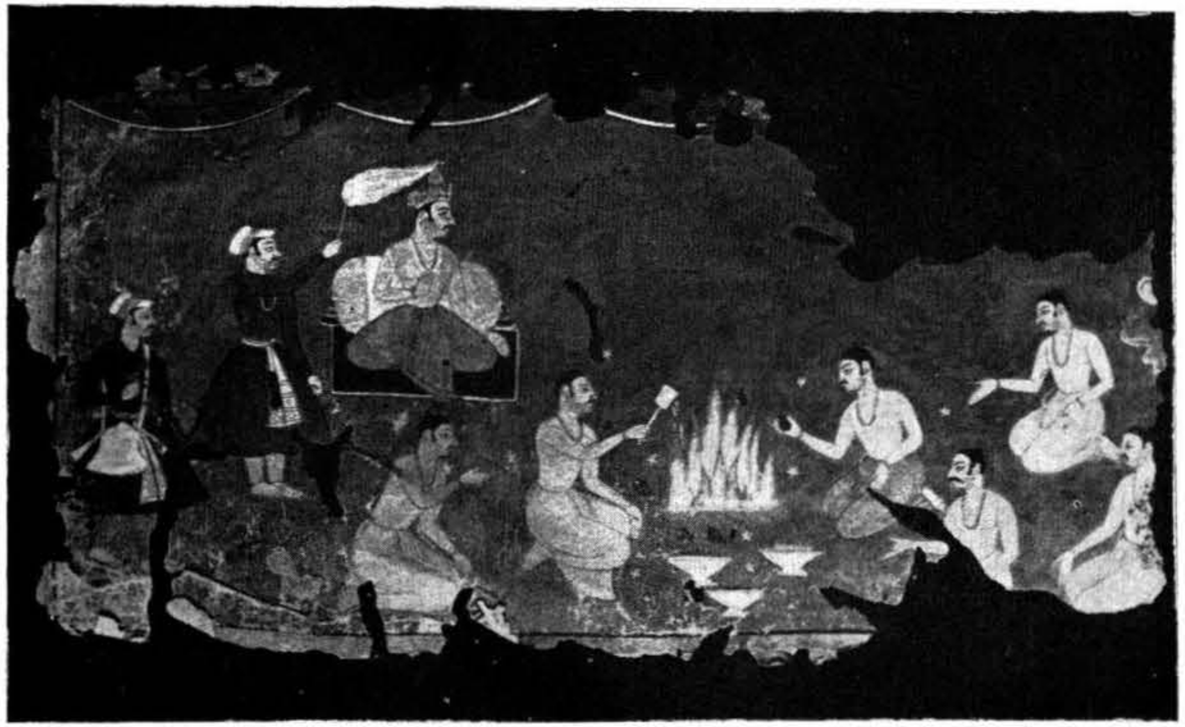

Figure 2. A leaf of a manuscript damaged by insects.

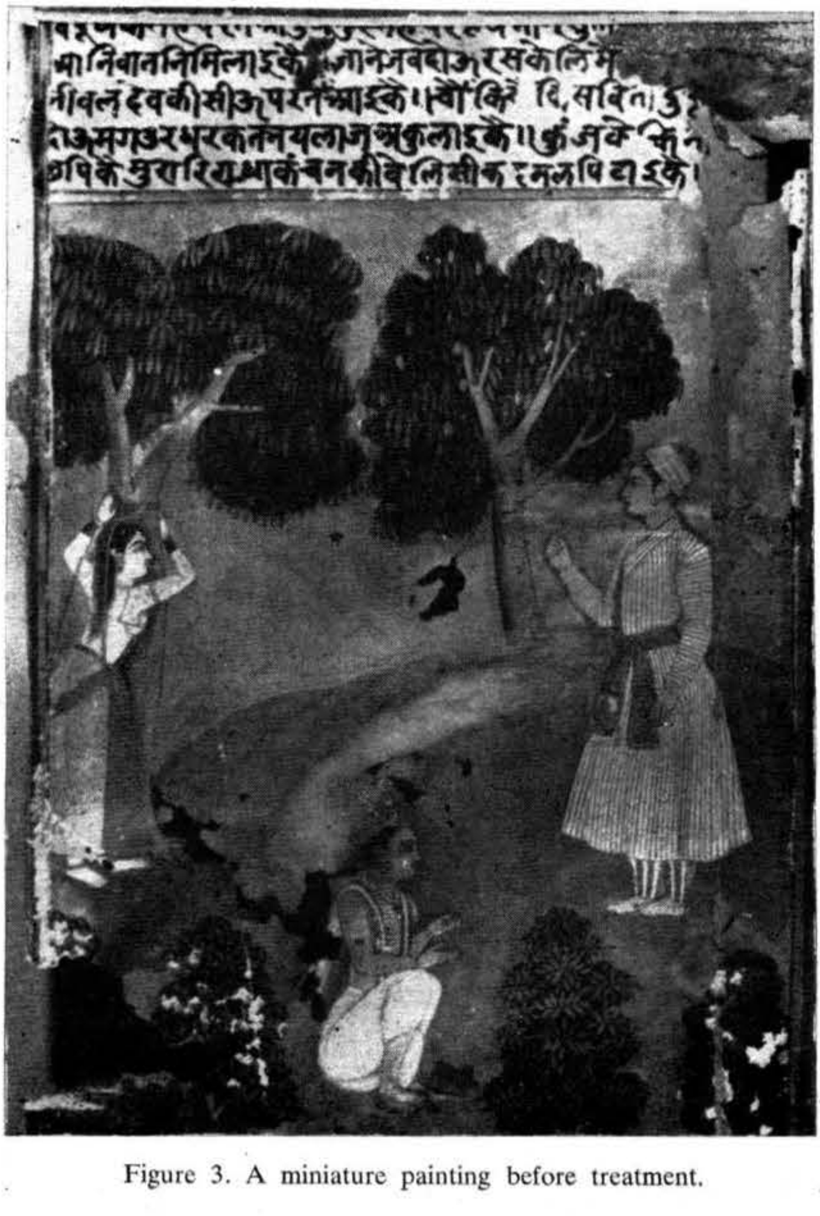

Figure 3. A miniature painting before treatment.

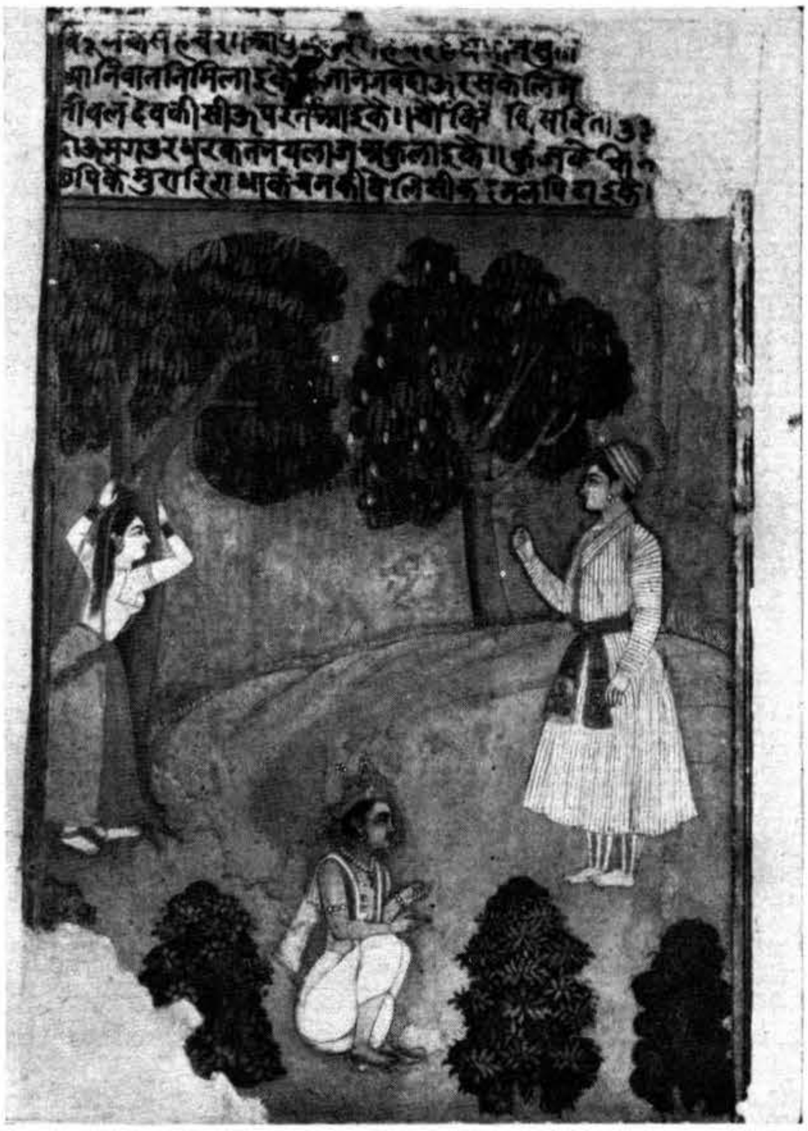

Figure 4. The same miniature painting after treatment.

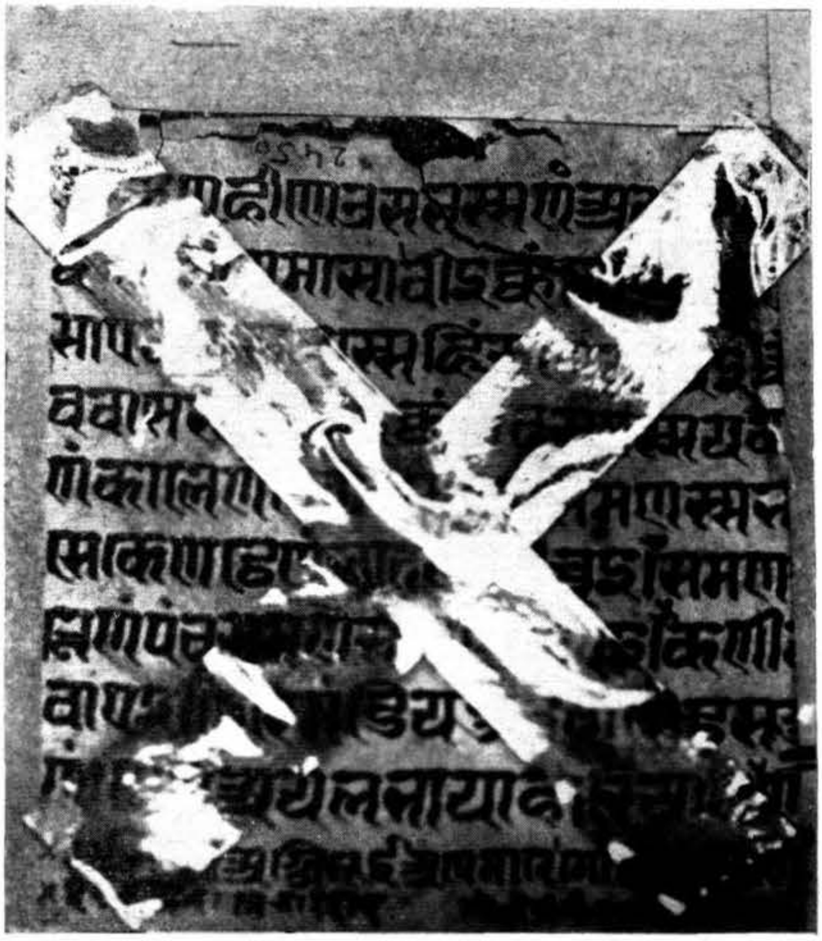

Figure 5. A leaf of a manuscript with cellotape. The paper of the manuscript had become extremely weak.

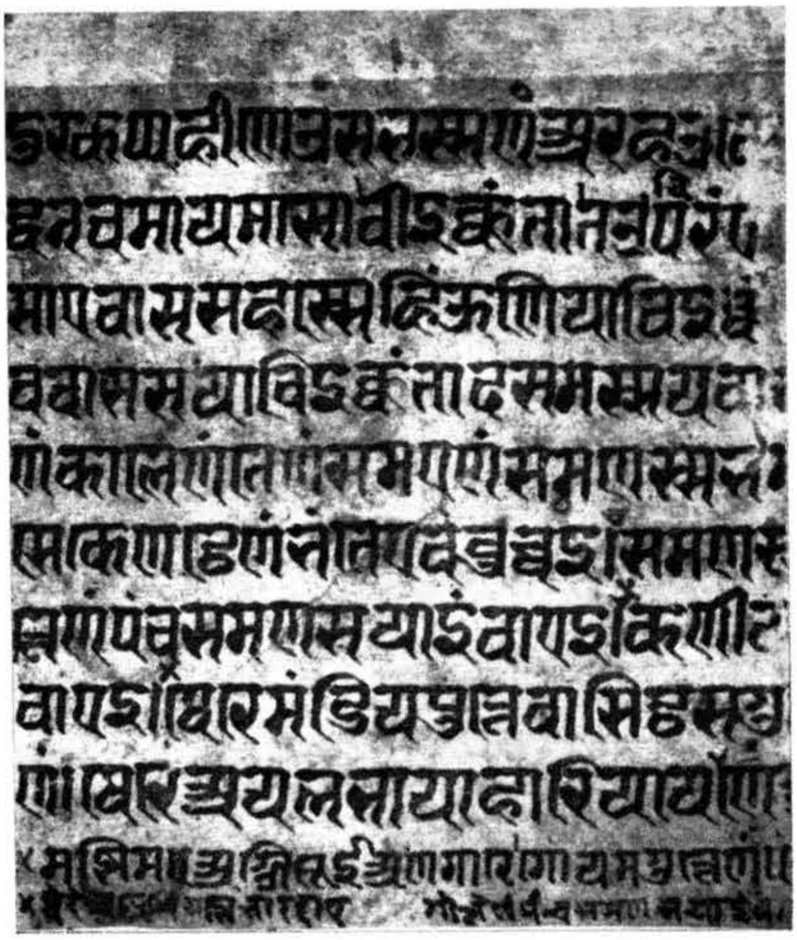

Figure 6. The same leaf of manuscript after removal of the cellotape and strengthening of the paper support.

delicate and many of the solvents and techniques which can be safely used for other types of paper documents may affect adversely the paintings.

Deterioration in a paper painting is a result of several factors. These factors could be categorized as :

(i) natural
(ii) accidental
(iii) intrinsic to the painting.

(i) *Natural factors*

The natural factors are heat, humidity and variations in the environmental conditions. For instance, it is well-known that high temperature leads to deterioration of paper and consequently the painting is also affected. Similarly, high humidity makes the paper limp and also leads to growth of fungus. Variations in the environmental conditions may lead to the flaking of paint. The reason is that as the humidity increases, the paper or the board on which the painting is done, expands and when the conditions are dry, it tends to shrink. The paint which is normally not hygroscopic cannot keep wth this expansion and contraction of the supporting material. As a result, there is a *'conflict'* between the two and the paint starts flaking.

Another natural factor which has an adverse effect on the paintings is light. Light, particularly in the ultra-violet range weakens the paper and also fades the colours. The phenomenon is very complex and as yet there is no solution in sight except the use of ultra-violet filters or ultra-violet coating on the light source.

Fungi and insects are some other natural factors of deterioration. Paper being very weak in nature is susceptible to both these factors of deterioration. Growth of fungi is connected with high humidity conditions. This can be a serious threat in the Tropics.

(ii) *Accidental factor*

The accidental factors of damage, as the term indicates, are for instance, the abrasion or the shock to the painting because of careless handling. Improper or ill-designed storage of paintings may also damage them and, therefore, proper storage of paintings is extremely important. More damage results, possibly due to this cause than any other. The storage should be designed not only for the environmental control but also to avoid accidental damage. When the paintings are sent from one place to the other, either inside the building or outside the building, for instance for exhibition, due care must be taken that they are saved from physical damage.

(iii) *Intrinsic factor*

Certain types of defects may occur due to the intrinsic property of painting or in other words because of the type of materials which have been used for the painting. For instance, an inferior quality of paper used for painting will lead to its deterioration. Certain types of pigments, like verdigris (of green colour) affects the life of the paper on which it is used. On those portions, the paper gets charred and finally it may be completely lost. Similarly, the presence of acidity in the paper will also lead to its destruction or deterioration.

Forms of Deterioration and Care

There are various types of deterioration that come about in a paper painting. These can be summarized as follows :

(i) *Formation of stains :*

Paper is an absorbent material and, therefore, it easily attracts dust and stains of various types. Even a drop of water placed on paper leaves on it a stain, because the impurities present in the paper dissolve and get concentrated around the water drop when it evaporates. There may also be stains of oil, of ink, of wax and so on. The remedy for the removal of stains is to use appropriate solvents, like xylene, acetone, trichloroethane, cellosolve, etc. In actual practice, this may be a difficult operation because the conservator has to ensure that the solvents do not dissolve away parts of the paint. In other words, he has to ascertain beforehand by testing on certain parts, that the paint is not being affected. Also for dissolving away the stains, force should not be applied.

Bleaching is very commonly used for the removal of stains from printed documents. Whether it can be used at all for paper paintings is extremely doubtful. The bleaching agents may have an effect on the dyes and pigments. Not only that, after bleaching the paintings have to be thoroughly washed with water and that may damage the paint. A research project in this direction is underway at the NRLC.

Drawings and sketches have sometimes been bleached with mild bleaching agents such as Chloramin T and Hydrogen peroxide. Hypochlorites and postassium permanganate are much too drastic for this purpose.

(ii) *Earlier restoration*

It is possible that when a painting is received in the museum, it had been repaired or restored earlier. Quite often, the repair may have been done in a manner that it becomes necessary to remove the old repairs. This situation arises, if for instance, the old restoration is covering parts of the painting or of the writing. It is also possible that the material of the old repair is such that it produces a strain on the painting-support or is causing stains or is harming the painting in some other manner. An example of this type is the use of scotch tape which is very dangerous to paper.

For removal of old repairing strips, the restorer should first ascertain the nature of the adhesive. Normally water or a mixture of organic solvents are used for loosening the old strips. However, the effect of these solvents on the paint and on the ink must be examined beforehand.

Experiments have been conducted for the use of enzymes for the separation of strips pasted with gum or glue. For removal of scotch tape, organic solvents are used.

(iii) *Acidity*

The presence of acidity in paper is very harmful. If the paper of the painting is found to be acidic, it is necessary that it is neutralized. For deacidification also, the techniques which are applicable to printed materials may not be suitable for miniature paintings. The reason is that the deacidification solution or treatment should not harm the paint or the ink in any manner. The deacidification techniques are of several types, namely with acqueous solutions, with non-acqueous solutions and with vapours. Each category has its own merits and demerits.

Aqueous deacidification has an advantage over the other systems because water being a good solvent of acidic products removes them during treatment. The most commonly used deacidification solutions are calcium hydroxide, calcium bicarbonate and magnesium bicarbonate.

Non-aqueous deacidification is carried out with alkaline chemicals, like barium hydroxide dissolved in methyl alcohol. The other non-acqueous deacidification solution is the magnesium methoxide.

The vapour-phase deacidification was carried out with cyclohexylamine carbonate, but not with much success. Ammonia vapours have also been used, but it is noticed that after some time ammonia volatilizes and the document becomes acidic again.

(iv) *Flaking of paints*

A very common defect in paintings is the flaking of paint. The first state of the flaking of paint is the formation of cracks either in the paint or in the ground. Due to various forces working on the paint it starts separating from the support and ultimately falls off.

Flaking is caused due to several factors : failure of the binding medium, shocks to the painting, abrasion in some manner or variations in the environmental conditions.

In a miniature painting, flaking can be prevented to some extent by the application of a new thin binder from the surface side, particularly if the loss of paint is due to the failure of the binding medium.

It should be ensured that the painting does not receive any type of shock or vibration. It is, therefore, stored in between window-cut matting boards or on a strong stretcher.

(v) *Fungus growth*

In hot and humid climate, like that prevailing in India, growth of fungus on paintings is a very common occurrence. Studies indicate that the fungi appear as black, green and yellow spots on the back and the surface of the painting. Sometimes the fungus is present between the constituent layers of the paper board.

For the prevention of fungal growth, maintenance of proper atmospheric conditions inside the storage as well as the exhibition areas of museums is essential. The room where the paintings are exhibited or stored should be well ventilated.

For sterilization of the paintings, fumigation with thymol vapours can be done. The paintings are kept in a sealed chamber inside which thymol crystals are kept in a glass container which can be heated from outside. Fumigation is done for about 15 days.

(vi) *Insect damages*

Insects, like silver-fish, cockroaches, crickets, book-worms are some of the most common enemies of paper paintings. It is necessary that the paintings are cleaned regularly and periodically, and proper insecticides are used inside the storage areas. Fumigation with chemicals, like paradichlorobenzene is also recommended.

(vii) *Weakening of the support :*

Very often, the original paper of the painting becomes fragile and weak. In such cases, steps are to be taken for the strengthening of the support by pasting another new paper at the back. The process is known as 'lining'. The new paper must be durable, flexible, without any staining effect and in general should match the original paper of the painting. Tests at the NRLC indicate that the Nepalese tissue paper which is produced in Nepal as a cottage industry has very desirable properties of a lining paper. The Japanese mulberry tissue paper which has to be imported from Japan is also excellent for this purpose. Experiments are now underway to develop an indigenous paper which may be useful for lining.

Lining of paper paintings is a very delicate process and the restorer may come across several variations and situations. For instance, if the painting is done on both sides of the paper, lining may not be possible. The restorer has also to decide whether full lining is necessary or only filling of holes or providing strips will suffice. In conservation work, much depends on the experience and the skill of the restorer.

Another important question in this regard is the type of adhesive to be used for pasting a new sheet of paper to the painting. Starch paste has been the normal choice. It is very compatible with paper.

Conclusion

It can be seen from the above brief discussion that preservation of paper paintngs is a complicated process and the method to be adopted will much depend upon the need of the situation. The problems presented by the individual case are to be studied in detail, and the composition of the components of the painting ascertained before taking a final decision. The methods useful for paper conservation can be applied only after careful changes suited to paintings.

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12. CONSERVATION OF MAPS IN THE NATIONAL LIBRARY, CALCUTTA

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Introduction

In a recent article, Dr. Ashin Dasgupta, Director, National Library of India, Calcutta, has said that if we are to save our core 19th century collection, there is an immediate need for proper conservation and adequate air-conditioning of the Library. In fact the work of conservation of books was taken up long back by the Preservation Division, of course not with some definite programme. The binding, mending or repairing of maps and atlases were done by the above division, as and when they were needed. In recent years, Laboratory Division has joined hands with Preservation Division in solving the problems of conservation. It is equipped with its reagents and machines to do justice towards the conservation of library materials in a new phased programme.

Nature of the Map Collection

In order to know the conservation work that is being done, it is necessary to know the nature of the collection. The stock consists of mainly 19th century and a few 18th century publications along with some manuscript maps. The current publications include the maps of the Survey of India, Geological Survey of India, National Atlas and Thematic Mapping Organisation, Naval Hydrographic Office and many such other publishing agencies of India and abroad. Thus, the collection has a mixture of old and new documents which call for varying degree of conservation. The majority of maps and atlases are of normal size *i.e.,* less than 107 cm. × 79 cm., but a few over size maps and atlases are also there, and received.

Acquisition of the Maps

The maps and atlases are received by this Library in rolls, in envelopes, in flat packages or wrapped in gunny bags. It is from this receipt point, the work of conservation starts. Occasionally, they are received torn or damaged. There were occasions, when careless opening of the packet results in damage also. The maps which are received otherwise in good condition, are first flattened and kept under slight pressure. For the rolled maps they are counter-rolled and then they are flattened. This is the first steps of conservation work in the library.

The second stage of conservation work starts when a map is required for a second time attention *i.e.,* torn or damaged while in use. These two stages are similar for an atlas also. The only difference is that an atlas has a protective cover and so the damage is little less in the initial stage than the map.

In this connection perhaps, it may not be out of place to inform that recently a railway parcel of 449 sheet maps of Survey of India has been received in a very damaged condition. Obviously, each sheet has to be scrutinised properly and only then proper decision can be taken for restoring them.

Care and Storage of Maps

Maps, because of their shape, size and lack of protective cover, require a special storage, which may be horizontal or vertical, even it may be of wood or steel. In majority, steel map filing horizonal cabinets are more generally used than vertical cabinet. In the National Library, there are both types of cabinets and they are serving well for last so many years.

Horizontal Cabinets

The National Library has these cabinets with six drawers and having 117 cm. (width), 86 cm. (depth) and 106 cm. (height) measurements. This is a large size cabinet and allows maps of less than 107 cm. × 79 cm. of dimension, without any buckling. Having a drawer height of 8.5 cm. (inside), a single drawer can accommodate 300 such sheets of average thickness of paper. In these cabinets not only new acquisitions are kept, but also the old ones, which are kept in bound book form. In the early days of National Library, these maps were sectioned into horizontal and vertical strips and then they were mounted on cloth and finally folded to book form. This practice has been discontinued and composite maps are mounted and stored flat.

The topographical sheets of Survey of India recently introduced a new series, 1 :50,000 (10 m. to 500 m.) measuring 84 cm. × 60 cm. (previously 56 cm. × 45 cm.), Naval Hydrographic charts (106.5 cm. × 72 cm.) and loose sheets of National Atlas and Thematic Mapping Organisation having (101 cm. × 58 cm.), all are kept perfectly flat in this cabinet. From the above measurements, it can be assumed that Indian maps are maintaining some standard in size and do not in general create much problem for storage. It may not however be taken for granted, that over-size maps are not published in India and abroad.

Some of the maps published during pre 1900 in India are of 104 cm. × 164 cm. or 150 cm. × 134 cm. sizes even. These maps were mounted on cloth and bound as books *e.g.*, Agra : Cantonment, city and environs, Calcutta, 1870, Scale 1″ to 6 miles, has been bound and folded to 34 cm. × 20 cm. in size. Recently published maps by M/S. Edward Stanford, London of Europe, U. S. A. etc. are of 112 cm. × 92.5 cm. size. UNESCO has published Geological map of Africa (in sheets) having 110 cm × 76 cm. size. There are a few others in this list, which cannot be comfortably put in the horizontal cabinet.

Vertical Cabinet

This type of cabinet is not generally seen in libraries or used in a few libraries only. The National Library, Calcutta, has acquired at least two such cabinets and is in use from the inception of the Map Dvision. It has its storage length of 124 cm., with its breadth of 95 cm. and can accommodate approximately 270 sheets of average thickness. Such a cabinet has some operating problem, *viz.,* opening and closing the cabinet, filing of maps and for keeping the index record of the maps, specially provided.

Future Storage

However, the National Lbrary receives some over-size maps which do not fit in properly in any of these cabinets but these maps are all the more important and due care has to be taken. Road map of India, published by Survey of India, Dehra Doon, 1969, scale 1″ to 40 miles has a size of 150 cm. × 119 cm. and is revised and updated once in four years or so. Such types of maps have a regular flow under the Delivery of Books (Public Library) Act of 1954. A few years ago, this Library acquired some 200 sheets of World Series, published from Federal Republic of Germany in collaboration with U. S. S. R. Each sheet measures 124 cm. × 95 cm. approximately and are stored as folded. This requires serious thinking for better storage of odd-size maps.

Repair and Restoration of Maps

There is no doubt that the storage facilities for maps keep away to a great extent the deteriorating factors. Yet the decay is inevitable in the normal condition.

Due to the physical, chemical and biological deterioration factors, maps and atlases require preservation methods.

Deacidification

The maps which are published approximately between 1870 and 1920 create the main preservation problem because of the quality of the paper used during this time. The acid content of the paper as well as accumulation of further acid from the atmosphere, make the paper brittle within a very short span of time. To save the document from further decay and to make it usable for another few years, de-acdification is done. A large bulk of Survey of India topographical sheets published during 1913-16 was received in 1980 as gift. On physical verification each sheet required de-acidification. They were deacidified and proper mounting was done.

Mounting

The maps and atlases under certain condition require mounting by wheat flour paste on 'Addi cloth or hand made paper' compatible with the material of the map. After deacidification mounting is also done. As a main mounting material, Addi cloth is of course used but a recent trend of 'Nepal hand made paper' is also being used nowadays. It is strong, durable and cheap also. 'Nylonnet' is being used for books but uptil now no map or atlas has been mounted by it.

As an alternative to flour paste, Dextrin/C. M. C. (Carboxy-methyl cellulose) are being used very much. Fevicol/Polymethylacrylate pastes are also in use. The pastes have great advantage, over normal flour-paste. They do not form lump, maintain proper consistency and finally, do not have any bad effect on the document.

The treatment of maps having shellac on the face of the map requires special treatment. In fact, shellac cover when cracks over the map surface is to be washed off with benzene, and then lacqured with bedacryl (2%) applied on the face of the map to give it a surface protection. However, mounting the map on the back side of the map remains the same. Soon after the mounted documents are dried, they are kept as flat under slight pressure (to avoid any buckling/curling) for some days. After that they are restored in the proper place.

Conclusion

The conservation of maps and atlases, now in practice, is not necessarily being the best. There are still further directions of improvement by constant research. Despite limited resources at hand, the conservation wing along with Map Division are constantly finding ways and means for better and more systematic methods for conservation. Soon the shifting of conservation wing to the new building that is coming up with it is hoped conservation will play an important role not only in this Library but also in India.

13. CREATION AND CONSERVATION OF PHOTOGRAPHIC RECORDS

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Introduction

Photographic records may include sheet film, roll film (negative and positive), photographic prints on film or paper and possibly colour films and prints. Although a wide variety of photographic materials are involved, the same care must be taken with each in the production of records required for archival purposes. Dyes of colour films fade over a period of years and as such they are not suitable for archival usage.

Photography is the process of forming visible images by the action of light on silver halides to bring about a change which is at first invisible but can be revealed by the action of a developer which converts the exposed silver halides to black metallic silver. The brighter parts of the subject photographed give more exposure to the silver halide and produce more blackening than the darker parts, so that a negative results. To produce a positive in which the relation between the light and dark areas corresponds to that of the subject, the negative is printed on to a similar light sensitive surface either by contact or by pre-action so that the negative tones are reversed.

Generally the basic requirements for the production of a photograph are as follows :

1. The camera which takes the picture.
2. The light sensitive material.
3. Illumination for the subject.
4. Processing chemicals and an arrangement for the processing.
5. A contact printing or projection device for the production of a positive.

The Camera

A Camera is a precision recording/copying device. It provides a camera-head with a lens, focussing mechanism, film transport and provision for taking photographs at different reduction ratios. Making ordinary photographs is a familiar procedure but making microfilms calls for an exceptionally high degree of care and precision. The camera must be rigidly built and should be free of vibration. The lens should be capable of giving extremely sharp and clear images and all critical parts must be made to extremely close tolerances. The relationship between lens axis, object and film planes require great precision and accuracy. The focussing mechanism and the light measurement and adjustment system require the same measure of accuracy.

There are two types of microfilm cameras : Planetary and flow.

A planetary camera photographs a document in a stationary position as it lies on a copy board. A flow camera photographs a document while it moves through the camera. Flow cameras have found wide use in the small document copying field, while microfilming of engineering drawings, oversize documents, bound and fragile documents is done with planetary cameras.

Planetary or Flat-bed Cameras

This type of camera has a stand holding the camera, allowing it to be raised or lowered while the document to be copied lies on a flat copy board. Such cameras are fitted with automatic or semi-automatic devices for focussing and an illuminating arrangement with a control for the illumination. Most planetary cameras use 35mm. film, although by the use of an adopter, it is possible to use 16mm. film. There are also such cameras employing only 16 mm. film. The film is usually transported automatically by one frame length after each exposure has been made, so that the camera is immediately ready for the next exposure. The work of positioning the document, moving the camera head upward or downward to adjust the field and the reduction ratio, adjusting the light intensity, operating the camera shutter, and removing the documents from the field, all are generally done by hand, although automatic exposure meters and motor driven devices to raise or lower the camera head are also being employed in some models. The planetary camera, generally used for copying archival materials, can handle fragile records, bound volumes, oversize records and newspapers. For bound volumes usually a book cradle is used. The planetary camera produces a film image superior in quality to an image produced by a flow type camera as the image is not in motion during the filming process.

Flow or Rotary Camera

A flow camera basically consists of a camera unit, a paper moving and guiding mechanism and light controls, all of which are enclosed in a light tight cabinet. Documents are fed either by hand or by an automatic feed attachment, through a slot in the front of the cabinet. The width of the slot varies in different models from 24cm. to 42.5cm. (9½″ to 18″ approximately) with most cameras equipped with 27.5 cm. to 30 cm. (11″ or 12″) slots. The maximum width of document that can be filmed is determined by the width of the slot. However, documents of almost any length can be filmed. In this type of camera both the documents and the film move in synchronism during the exposure. Most of the flow cameras use 16mm. film and are ideal for rapid and economic microcopying of extensive files or of vast numbers of smaller documents such as cheques, drafts, indexes, punched cards, etc. The operation of a flow type camera is very simple as it is restricted to the feeding in the documents and loading the film. The output is therefore, very high : 6,000 to 7,000 exposures per hour are within the scope of these cameras. Of course the documents must be thin, loose, flat and in a good state of preservation. These cameras are not suitable for fragile documents, stitched files, books or large documents.

The Flm—Photographic Emulsion

The photographic emulsion which is actually the sensitive material, consists basically of a suspension of silver halide crystals in gelatine, prepared by adding a solution of silver nitrate to a solution of halides in gelatine. The silver halides used are the chloride, the bromide and iodide. During manufacture chemicals are added to control the sensitivity or speed, grain size, resolving power, contrast, to harden the gelatine and to sensitise the film to the desired wave-length of light. A non-sensitive gelatine overcoat may also be given to prevent abrasion while handling film. The film also has an anti-halation backing to prevent the effect of internal reflection in the thickness of the base.

Paper emulsions which are slower than films are generally coated thinner than film emulsions and are more highly hardened.

Colour Sensitivity of Emulsions

The silver halides are normally sensitive only to the ultra-violet, violet and blue but they can be sensitised to other wave-lengths by adding to the emulsion special dyes usually of the carbocyanine or merocyanine class. This is known as optical sensitising. In order to represent tone values, the photographic emulsion must respond to all wave-lengths to which the eye is senstive *i.e.* wave-length between 3900-7600 A° (violet to red).

Non-sensitised emulsions are known as blue or colour blind emulsions while those in which the sensitivity has been extended upto green/yellow are known as orthochromatic. When the sensitivity is increased further to red, the emulsions are known as panchromatic. Panchromatic emulsions give a good tone rendering of coloured objects. Orthochromatic films which reproduce reds as dark are used in commercial and industrial photography and in the graphic arts. Colour blind films are used for duplication on film. The sensitivity of films can be extended to the near infra-red region and such infra-red film have many applications *e.g.* in criminology.

The film used for copying of documents is high contrast, very fine grain, of slow speed and high resolving power and panchromatic.

Base Materials

The base materials used for the photographic emulsion are the glass plates, plastic film or paper.

The glass supports are preferred for optical clarity, their flatness and freedom from dimensional changes. Film supports which for many years consisted of cellulose nitrate which is highly inflammable and self-igniting now-a-days consists of a thin flexible transparent optically uniform sheet of cellulose acetate or mixed esters whch is called safety film on account of its slow burning property. In recent times increasing use is being made of polystyrene, polycarbonate or polyester films in view of their higher dimensional stability. Film base for permanent records should conform to USA Standard Specifications for "Photographic Film for Permanent Records PH 1.28-1957" or its latest revision.

Photographic paper is made from rag stock or from wood pulp specially prepared free of chemical impurities and has a high wet strength. It is usually coated with a suspension of baryta (barium sulphate) to impart a high reflectance.

Sources of Illumination

The most important source of illumination in photography is of course, day-light. Other sources producing artificial illumination such as tungsten lamps and arc lamps are also commonly used. Flash bulbs which generate light by the rapid combustion of some materials such as a thin aluminium or magnesium foil or wire in oxygen or electronic flash which produces a high intensity illumination by an instantaneous electric discharge between the electrodes in a gas-filled tube are also often used in photography. For special applications such as the photography of charred or faded documents, sources of infra-red or ultra-violet radiation are used.

Filters in Photography

Filters are used in photography to modify the light falling on the subject or passing through the camera lens by placing them over the lamps or on the camera lens.

Filter Factor

Filters act by absorbing part of the light that is reflected by the subject and this naturally has to be compensated by an increase in exposure. The increase is given by the filter factor.

Filters in black and white photography are mainly used on the camera. (i) Filters used to correct the imperfect colour rendering, by the sensitive materials which are more responsive to the blue and violet radiation than the human eye are generally of a light and medium yellow colour. These filters act by cutting out partially the blue radiation from the subject photographed. Such filters are called *correction filters.* (ii) Filters used to distort (brighten or darken) the reproduction of certain colours for special effects. Examples of such use are the use of a deep red filter to darken the blue sky in a picture or the use of a deep yellow filter to lighten the background and darken the text in copying a yellowed document with blue text and (iii) filters as to take pictures by using selected radiation such as infra-red or ultra-violet rays say in criminology.

Types of filters

Filters are generally of three types :

(i) *Gelatine filters* produced by dyeing gelatine to the required colour and using the gelating filter either separately or sandwiched between glass discs. Gelatine filters are easy to make but suffer damage by abrasion.

(ii) *Glass filters* prepared by coloured glass are more robust. The range of colours in which they can be produced is, however, limited.

(iii) *Liquid filters* which are solutions of certain chemicals in suitable glass cells. These are specially useful in scientific work.

(i) The chemical used shall be of photographic grade and shall conform to the relevant Indian standards.

(ii) Water for preparing solutions for the processing of films and their washing shall be soft and free from suspended and bacterial impurities. Portable water meets the requirements.

Processing

Processing is one of the most important factors contributing to the ultimate permanence of films. Processing refers to various steps that lead to a readable image after exposure. The various steps involved are, developing, fixing, washing and drying. The image is made visible by developing in reducing agents which convert the affected silver salts to silver, while leaving unexposed portions as they were. After development, the unaffected silver halide is removed by fixing in a solution of sodium thiosulphate, also known as 'Hypo'. After fixing, the photographic material is washed thoroughly in running water to remove all residual chemicals. Finally the film is dried, preferably by warm air circulation.

The life of the film may be said to start in the darkroom. Proper fixing of the film to eliminate light sensitive residual salts and chemicals, is essential to prevent the eventual staining and fading of the images. After processing the microfilms should contain not more than 0.005 mg. of sodium thiosulphate per square inch of the film. Films received for storage should also give a negative indication when tested for the presence of silver compounds. Tests for residual hypo and silver compounds are given in the appendix.

The requirements for proper processing of the films are as under :—

(i) The chemicals used shall be of photographic grade and shall conform to the relevant Indian Standards.

(ii) Water for preparing solutions for the processing of films and their washing shall be soft and free from suspended and bacterial impurities. Potable water meets the requirement.

(iii) The films, after exposure, shall be processed in accordance with the recommendations of the manufacture. Addition of 0.2gm. per litre of potassium iodide to the fixer in processing microfilms helps prevention of formation of micro-spots.

(iv) The temperature during development shall be maintained within the range recommended by the manufacturer, preferably at about 20°C (68°F).

(v) Washing shall be thorough in running water at a temperature of 15 to 25°C so as to ensure that the residual hypo content is low enough to give a negative indication when tested.

(vi) The films shall be air-dried in an atmosphere free of dust, smoke, gases, vapours and fumes injuries to the film.

Positive printing and enlargement

Negetative provide the primary records in black and white photography and in some cases, such as in document reproduction work, they may be used as such. However, generally a positive copy, which resembles the original in tone, is required. This positive is prepared from the negative either by contact printing, or by projection printing (in an enlarger) form of Microcopies. Microcopies can be made on film roll, sheet film or paper and can be classified in two forms :

(i) Microtransparencies

(ii) Micro-opaques

Microtransparencies : They are read by transmitted light and can be made in the following form (a) roll microfilm (b) microfilm strip (c) microfiche or sheet microfilm.

Roll microfilm

Microfilm (roll microfilm) is the basic form of microphotographs in linear array. Standard film widths are 16 mm., 35 mm., 70 mm. and 105 mm. 35 mm. film is preferred in the library and archives as it is economical and at the same time easier to handle. The film may be either unperforated or perforated along one or both edges. Most microfilm cameras today use unperforated film, as the use of perforated film results in the loss of about 25% of the useful area of the film. This is so because the image on the film must be kept in the area between the perforations. Most microfilms produced to-day of archival materials, newspapers and books is 35 mm. on reel of 100 feet (30.5 meters) although occasionally 70 mm. or even 105 mm. microfilm is used for the drawings and plans that cannot be microfilmed satisfactory on 35 mm. film.

Unitized Strip Microfilm

A microfilm in roll form has some limitation in that it does not normally have ready means of locating a required page in view of the large number of documents it contains. Therefore, to faci- each of which becomes a unit. They are referred to as unitized microfilm. Unitized film is prepared from roll microfilm and is usually in the form of (i) microfilm strips which contain 6 frames. The first frame usually shows the little of the document in type which can be read by the naked eye. The five frames following may each contain two pages of the document, thus giving ten pages per strip. (ii) Acetate Jackets containing a strip or strips of film which can be read while still in the jacket. These jackets may contain typed indexing information on the documents they contain, and (iii) Aperture cards containing an aperture in which individual frames of microfilm can be mounted. The cards can be of any size or shape including punched cards for manual or mechanical sorting.

Microfiche

A microfiche which is another form of unitized microfilm, consists of a number of rows of reduced images of documents produced on transparent sheet. There are a number of ways in which microfiche may be made. They may be produced by inserting strips of microfilm between clear acetate jacket, by placing strips of microfilm in a special holder, or by using special cameras known as 'Step and Repeat cameras', which record images in a series of rows on sheets of film like a typewriter. Microfiche is produced in a variety of sizes of (i) 3″×5″ (75×125mm.) (ii) 3½″×4¾″ (90×120mm.) and 4″×6″ (105×140mm.) size which is quite common in Europe.

Ozalid or diazo type film consists of cellulose acetate base that has a light-sensitive diazo dye either incorporated in the film base or coated on the base. When this film is exposed to ultra violet and blue light and developed by an ammonia vapour or an alkaline solution an image is formed. With this process a negative image will produce a negative image.

Kalvar film consists of polyester (mylar or cronar) film that contains a diazonium emulsion. This film when exposed to ultraviolet light and then processed by heat, forms an image. With Kalvar film a negative image will also produce a negative image.

Kalvar and ozalid films are at present, not suitable for use in a microfilm camera but only for preparing film duplicates. They are not approved for archival permanence. Both ozalid and Kalvar film are generally more suitable, for the reproduction of film copies from high contrast materials such as news-papers or line drawings than they are for the reproduction of archival materials. Micro-opaques : There are three common sizes for the micro-opaques, 3″×5″ (75×125mm) 6″×9″ (150×225mm) and 6½″×8½″ (165×215mm). They comprise micro-text images printed from rolls of 16mm on paper base rather than film. They have a number of advantages over transparent microfilms and psychologically have a wider appeal than micro records produced in any other form. Like the microfiche they provide convenient filing potential. Because of the paper base they are stronger and more durable and therefore, more easly indexed, can be adopted for edgepunching, and are less susceptible to damage by handling. Unlike the microtransparencies, the micro-opaques can only be read by reflected light. The following are the three types of micro-opaques.

(i) *Microcard :* It is of 3″×5″ (75×125mm) in size and consists of number of rows of reduced images of documents reproduce on an opaque card by photographic process. Two microcards may be laminated back to back to give a two sided microcard.

(ii) *Microprint :* It differs from microcard in two important aspects. Firstly, it is a large card being 6″×9″ (150×225mm) in size and secondly it is printed by photo lithography and therefore, has an ink, and not a photographic image. Each card of microprint can contain 100 images with an eye-readable bibliographic entry along one side.

Conservation of Photographic Records

Conservation involves proper storage conditions, storage equipment, care in handling and a schedule of inspection and restoration of worn-out prints and negatives. Films should be provided with adequate leaders to give protection to the image portion of the film roll from external contaminaton.

Storage conditions

Photographic film and paper are more delicate medium than paper. Under unfavourable environmental conditions of storage they are much more susceptible to deterioration than paper. High relative humidity encourages the growth of mould while low humidity below 30% makes the film brittle. It is, therefore, essential that photographic records intended to be preserved for a considerable length of time are stored under proper environmental conditions and handled very carefully. For this, an efficient air-conditioning system, working round the clock is a must. Optimum storage conditions for preservation are a temperature of 20-22°C and relative humidity of 45-50%.

Studies on image permanence indicate that even if hypo and silver salts might be removed completely from the image, it would still be subject to deterioration when attacked by external gases like ammonia, hydrogen peroxide, hydrogen sulphide or sulphur dioxide. The air of the storage area should be filtered to remove dust and should be given an alkaline wash to make it free of acidic gases and circulated under slight positive pressure. Sufficient fresh air should be drawn in continuously to satisfy the needs of personnel working in the conditioned storage area. Fire protection arrangement should also be provided.

For providing protection whether on film or some other medium, more than one copy should be stored and in different locations. The negatives and the positives should be kept separately.

Paper prints should be dry mounted using dry mounting tissue on a good quality mounting board, and further protected by inter-leaving with glassine paper. Sheet film negative and positives may also be stacked by similar inter leaving or kept in acid-free envelops.

The photographic records should be properly arranged, identified and indexed so that individual documents can be located easily.

Storage equipment

Reels: Both negative and positive microfilms, in accordance with the accepted practice, are maintained in lengths of not more than 110 feet (33.5 meters) on reels with an internal diameter of not less than 2.5cm. Longer lengths are unwidely and may not fit into standard containers. The reels should be made of non-corrosive materials such as non-ferrous metal or stable plastics that are free of peroxides. The use of rubber bands around microfilm reels should be avoided because the rubber may contain residual sulphur, which is harmful. The use of adhesive tapes, tape splices, bleached paper, or printed paper such as newspaper, around microfilm reels also has adverse effects and should be avoided.

Reel containers and cartons: The most acceptable containers for storing negative microfilms are corrosion-resistent metal cans, e.g., cans made of anodized aluminium. Cardboard containers may be used for the storage of negative film only when they are relatively acid-free and non-peroxide producing.

Shelves and Cabinets: To ensure preservation, both negative and positive microfilms should be stored in fire proof and dust proof cabinets preferably made of steel that have been carefully constructed and treated with non-corrosive, non-staining, non-combustible paint. These cabinets should be designed so as to prevent dirt and dust from the air settling on the film containers and permit free circulation of the air in drawers and compartments. The lowest drawer should be at least ten to fifteen centimeters above the floor.

Care in handling: To protect film from scratches, lint, dust, and other materials that might damage or distort the film image, take the following precautions :

(a) Always wear white-cotton, lint-free gloves when handling film of any kind.

(b) Always hold film by its edges, never on its flat surfaces.

(c) Never wind film on the reel too tightly nor grab or hold the end of the film and pull it to tighten it on the reel. Wind film on the reel only as tight as the camera, viewer, or other rewind mechanism permits.

(d) Before using viewers, microscopes, densitometers, etc. always clean all parts that will come in contact with the films, and keep them clean during use. Dust is a deadly enemy to film.

(e) After the service copy of the microfilm has been produced, inspected and accepted, use the original camera negative only in emergencies.

(f) Never use a viewer that has revolving flats to view camera negative microfilm or any other microfilm. Such viewers tend to scratch the film.

(g) Keep chemicals and chemical fumes away from film-storage and film use areas. Never use alcohol to clean film ; use film cleaner (photographic).

(h) Wind and store film on plastic instead of metal reels. In humid areas metal tends to rust and the rust penetrates the film emulsion.

(i) Periodically check stored film. This check is most important. Check for fungus, mildew, film stickiness, too tight winding, image etching etc. Perform this check at least annually and more often in areas of high or very low natural humidity, especially if film is not maintaned under controlled temperature and humidity.

Negatives should not be placed close to radiators nor should they touch a light bulb or anything that might melt the emulsion. While laying a negative down it should be placed only on a clean, smooth surface with its emulsion side facing up. Paper clips should not come in direct contact with the negative or paper print. A piece of clean paper should protect the negative or print from the clip.

Inspection and Restoration

Photographic film records should be inspected after every use and any damage to the record should be repaired promptly and reel and cans showing signs of corrosion should be replaced before they are sent back for storage.

Film stored even under ideal conditions may have ecquired some kind of contramination. It is therefore, desirable to set up regular schedule for inspection. Films should be examined at least once every year and should be checked for base end image condition etc. For general cleaning recommended film cleaner should be used.

Films already processed without previous consideration for archival storage should be tested for residual hypo. If the residual hypo exceeds the limits specified, the films should be rewashed, provided that the gelatine in the emulsion has not already been damaged by fungus or moisture and become water soluble. If this has occurred, the film should be first carefully cleaned and then duplicated.

If fungus has attacked the film it should be carefully examined to determine the extent of the damage. If the emulsion has not been attacked the fungus may be removed by washing with water using a very small amount of sodium bicarbonate. However, if the fungus has reached the gelatine of the silver emulsion, water should not be used since fungus reduces the gelatine to a water soluble product. In this case, a solution of denatured alcohol with one table spoonful of ammonia to 100cc of alcohol, will be found effective.

It may however, be stated that with all valuable records it is advisable to attempt duplication by photography before testing or treating the records chemically. Film negatives can often be contact printed on to a record film. Faded or stained prints can often be photographed on a copying camera using appropriate filters. Faded and stained prints could also be restored by a bleach and redevelopment process.

One other change that occurs with time is the formation of small coloured spots or microblemishes-red or yellow in colour. The spots are believed to be caused by local oxidation of image silver resulting in the formation of minute deposits of colloidal silver. These could be controlled by using 0.2 gm per litre of Potassium iodide in the fixing bath and removed by immersion in ammonia-hypo reducer.

APPENDIX

TEST FOR RESIDUAL HYPO CONTENT IN PROCESSED *FILMS*

Preparation of standard sample

A strip of film of the same type as under test and exposed and developed for the same period, fixed twice in two fresh fixing baths consisting of 250 gms of hypo in one litre of water shall form the standard sample. The standard sample after fixing shall be washed in running water for one hour and shall be air-dried.

Test Method

A test strip of 625mm. is kept in 10cc of a solution containing 25gms. of mercuric chloride and 25gms. of potassium bromide in one litre of distilled water. If the solution shows no turbidity after 15 minutes, the hypo elimination is considered as satisfactory. The transparency of the solution containing the test strip shall be comparable to the standard sample kept in a similar manner.

A more accurate estimation may be made by a test based on Craptrie and Rose method. In this method the turbidity of the solution containing test strip is compared with three similar vials of mercuric chloride, potassium bromide solution (containing in each 10cc. of solution containing 25gms. of mercuric chloride and 25mgs. of potassium bromide in one litre of distilled water) one containing no hypo, the other with 0.005 mg. of hypo and the third with 0.010 mg. of hypo. The turbidity of the solution containing test strip should not exceed that of the solution containing 0.005mg. of hypo.

Spot test for residual hypo in processed films

A spot test is caried out by putting a drop of 1% solution of silver nitrate on the clear margin of a film, it will produce a colouration in excess of pale cream when the hypo content of the film exceeds a safe level.

Test for residual silver compounds in processed films

A drop of 0.2 per cent sodium sulphide solution is put on the clear margin of the film after washing and drying. After two or three minutes the spot should be carefully blotted. Any colouration produced by the formation of silver sulphide in excess of a just visible cream tint indicates the presence of silver compounds in the film. For more accurate results a standard sample may be prepared as described earlier by processing an unexposed strip of film through two fresh fixing baths and making a spot test on this strip also, for comparison with the sample under test. The colouration or tint produced in the test strip should not be deeper than that developed in the standard sample.

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14. ORGANISING COMMITTEES FOR THE SEMINAR ON CONSERVATION OF LIBRARY MATERIALS, 1985.

1. Advisory and Co-ordination Committee

(a) Prof. Ashin Das Gupta, Director.
(b) Sm. Kalpana Dasgupta, Librarian.
(c) Shri S. M. Hasan, Dputy Librarian
(d) Shri M. N. Nagaraj, Deputy Librarian.
(e) Shri H. C. Gupta, Deputy Librarian.
(f) Shri Avinashi Lal, Deputy Librarian.
(g) Shri Amal Ch. Das, Assistant Librarian.
(h) Dr. S. N. Khanna, Administrative Officer.

2. Committee for Editing and Printing

(a) Prof. Ashin Das Gupta, Director.
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(c) Shri H. C. Gupta, Deputy Librarian.
(d) Shri Avinashi Lal, Deputy Librarian.
(e) Shri Amal Ch. Das, Assistant Librarian.
(f) Shri V. Kotnala, Microphotographer.

3. Finance Committee

(a) Sm. Kalpana Dasgupta, Librarian.
(b) Shri Avinashi Lal, Deputy Librarian.
(c) Shri Amal Ch. Das, Assistant Librarian.
(d) Dr. S. N. Khanna, Administrative Officer.

4. Exhibition Committee

(a) Shri A. B. Roy, Assistant Librarian.
(b) Sm. Kalyani Moitra,Assistant Librarian.
(c) Sm. Arati Banerjee, Assistant Librarian.
(d) Shri N. N. Sarkar, Chemist.
(e) Shri Sanjib Sengupta, Display Assistant.
(f) Shri P. K. Sarkar, Foreman.

5. Reception Committee

(a) Shri M. N. Nagaraj, Deputy Librarian.
(b) Shri S. P. Banerjee, Assistant Librarian.

(c) Shri V. Kotnala, Microphotographer.
(d) Shri S. N. Bhaduri, Superintendent.
(e) Shri S. R. Bose, Superintendent.

6. Committee for Boarding, Loding, Transport and Purchase

(a) Shri H. C. Gupta, Deputy Librarian.
(b) Dr. S. N. Khanna, Administrative Officer.
(c) Shri N. C. Mandal, Administrative Officer.
(d) Shri S. K. Sarkar, Superintendent.
(e) Shri S. R. Bose, Superintendent.

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Group photograph of the delegates & participants of the Seminar on "Conservation of Library Materials" held in the National Library, Calcutta-27 on 21st & 22nd Jan. 1985

Group photograph of the delegates & participants of the Seminar on "Conservation of Library Materials" held in the National Library, Calcutta-27 on 21st & 22nd Jan., 1985.

16. PROCEEDINGS OF THE SEMINAR ON "CONSERVATION OF LIBRARY MATERIALS" HELD AT THE NATIONAL LIBRARY, CALCUTTA-27 ON 21ST AND 22ND JANUARY, 1985

Welcome Address :

The Seminar started at 10 a.m. on 21st January, 1985 at the auditorium of the National Library, Calcutta with the address of welcome by Smt. Kalpana Dasgupta, the Librarian, the National Library, Calcutta, to the distinguished delegates of the Seminar. She emphasised the role of the National Library as the pioneer institution in the field of Conservation from the days of Imperial Library as early as in 1920. She recalled the services of Shri B. S. Kesavan, Late Y. M. Mulay, Shri D. R. Kalia, Shri C. R. Banerji, Late A. B. Sen Gupta, Shri B. B. Chaudhuri, Dr. R. K. Das Gupta and Shri H. R. Sood in developing the conservation activities of this national institution.

Director's Address :

Prof. Ashin Das Gupta, Director, the National Library, in his address put before the house certain problems facing the National Library at present. He observed that the librarians were always caught in a paradox. He pointed out that already several hundred thousand items required immediate attention, while annually about 80,000 items of periodical issues were added to the existing problem. "Physical conservation can only be attempted in a limited scale, whereas the National Library charged with the responsibility of preserving the printed national heritage. How the National Library, could discharge its responsibilities consistent with the maxim "books are for use", is a great dilemma. It is as if we fight the demon as it grows. He suggested a national conservation centre with four regional centres to preserve the heritage based on co-ordinated efforts. In his opinion no nation could hope to preserve in any single library everything it prints. The National Library would, therefore, in the coming quarter of a century concentrate more and more on preserving its material, both old and contemporary, in microforms. However, efforts to conserve this heritage through physical methods would continue. Research would also be undertaken to discover what we may do for such preservation under Indian conditions.

Keynote Address :

In the absence of Shri B. S. Kesavan and Dr. B. B. Lal, Shri P. B. Roy, former President of Bengal Library Association and Lecturer of Library and Information Science of Jadavpur University, Calcutta acted as Chief Guest and delivered the keynote address. Referring to the five laws of library science, he observed that no library could function properly without proper care and maintenance. He emphasised the need for a scientific plan for preventive as well as curative preserving measures of library materials. He also advocated for application of advanced and scientific techniques of conservation.

Thereafter he formally released the "Souvenir" published during this occasion for distribution to the delegates in the audiance.

Vote of Thanks :

Mrs. Kalpana Dasgupta proposed the vote of thanks to delegates and participants.

Session One (General) on 21st Jan., 1985 :

Chairman, Shri Subodh K. Mukherjee, formerly Head of the Department of Library Science, Calcutta University.

Shri H. R. Sood, Officer on Special Duty, Raza Library, Rampur, (formerly Officer on Special Duty, the National Library, Calcutta) presented his paper on "Importance of Conservation of Library Objects" in which he emphasised the need of preserving manuscripts and printed materials in the library for their outstanding and permanent value for future use. In his opinion The National Library, Calcutta, should be the centre for conservation for the entire eastern region.

Initiating discussion on this paper Dr. B. P. Barua, Director, Raja Ramohun Roy Library Foundation, Calcutta, observed that while the Foundation could hardly afford to spend a very meagre amount on library conservation, the National Library should be the Centre for preservation to which the state central libraries and regional libraries should be linked up as a part of a national programme for conservation. This centre should be capable to advise and undertake the treatment to be meted out for rare and valuable materials. He also advocated, after seeing the conservation activities in the National Library, that the National Library should act as a "Book Museum" also on the line of British Museum (King's Library).

Dr. A. K. Ohededar, former Chief Librarian, Jadavpur University, submitting his paper highlighted some of the important points on "Education in Library Conservation in India". He observed that conservation is an indispensible and important function of the libraries particularly urgent and pressing in tropical countries like India where paper deteriorates faster due to climatic conditions and its composition. No serious efforts have been made for the development of education and research in library conservation in this country. Education should be both formal and informal and at two levels—one at higher level for conservation-scientists and the other at lower level for conservation-technicians. He deplored the present state of conservation education in India. He also proposed that the National Library should also establish its own 'School of Library Conservation' and suggested a course of action for the purpose.

Lively discussions followed, in which Shri Prabir Roy Chowdhury, Head of the Department of Library and Information Science, Jadavpur University, Calcutta ; Shri Sibdas Choudhury, Librarian, Asiatic Society, Calcutta ; Prof. P. K. Mahapatra, Reader, Department of Library Science, Calcutta University ; Shri A. Lal, Deputy Librarian, the National Library, Calcutta ; Shri Santosh Kr. Bose, Head of the Dept. of Museology, Calcutta University ; and Shri P. B. Roy, Lecturer, Department of Library and Information Science, Jadavpur University also participated along with others.

Shri Prabir Roy Chowdhury, while supporting Dr. Ohededar's propositions said that conservation as a subject was largely being neglected in the library science course persued in the universities. He also pleaded for, at least, one conservation specialist in major libraries and to impress upon U. G. C. (University Grant Commission) for liberal sanction. His emphasis was on both formal and informal education in conservation. The National Library should also conduct a full time course in conservation in correct perspective of the country's requirements. Prof. Mahapatra cited the case of Calcutta University and said conservation as a subject was largely neglected even in M. Lib. Sc. Courses. He deplored the present state of libraries' collections in this country. He pleaded for practice oriented education in conservation with the National Library, Calcutta taking the lead in this respect. Prof. Santosh Kumar Bose of Calcutta University pleaded that the efficiency of our traditional methods of preservation should be explored. He pointed out that conservation had wide connotation in the context of country's cultural heritage. He also felt the need for suitable vocabulary for terms used in conservation. Shri P. B. Roy assigned his priorities in matters of conservation as follows.

"Firstly we should organise workshops in different places on the basic aspects of conservation. Secondly we should convince the funding authorities that expenses on conservation is not a waste. Thirdly our professional association have also a vital role to play in this field."

Shri Subodh K. Mukherjee summed up the discussions as Chairman of the general session.

Session Two (Technical) :

Chairman, Shri P. K. Mahapatra, Reader, Department of Library Science, Calcutta University.

Shri A. Lal, Deputy Librarian, the National Library, Calcutta, presented his paper "Modern book—A problem". He highlighted the role of books as the main stay of information carrier in any library which are faced with the problem of deterioration while in storage. Manufacture of right type of paper is the need of the day. He discussed about a new technology which eliminates alum and produces permanent paper with alkaline reserve. It is for the librarians to emphasise the need for permanent paper which proves economical in the long run. As for existing stock he stressed the need for deacidification for stabilisation of paper before restoration by various modern processes.

Interesting discussion followed in which Shri Arun Ray, Secretary, Bengal Library Association ; Dr. B. P. Barua, Director, Raja Rammohun Roy Library Foundation, Calcutta ; Prof. P. Roy Chowdhury, Head of the Department of Library & Information Science, Jadavpur University, Cal-Calcutta ; Shri P. B. Roy, Lecturer, Department of Library & Information Science, Jadavpur University, Calcutta ; and Shri N. C. Mukherjee, G. M. of Government of India Press were among the participants besides others. The concensus was for printing of books on good quality paper which should give permanency and durability to the library collection and thus facilitate the cause of conservation. The participants were unanimous that this could be achieved through the co-ordinated efforts of the librarians, publishers and the government.

In the absence of Shri O. P. Agarwal, Head, National Research Laboratory for Conservation of Cultural Property, Lucknow, Shri S. K. Das, Conservation Officer, Asiatic Society, presented his paper on "Preservation of Paper Painting".

The paper discussed at length the anatomy of paintings on paper, along with the various organic and inorganic ingredients used in it. It further discussed the natural, accidental and intrinsic factors which are responsible for damages. The paper made a point that the restoration of paintings on paper was more complex than restoration of manuscript or printed materials. The paper dealt in details how the paper paintings are to be restored.

Shri Arun Ghosh, an expert on restoration of paintings, Victoria Memorial Hall, Calcutta, further explained the various points which were raised by the participants.

The paper submitted by Shri Ranbir Kishore, Chief of Conservation, National Archives of India, New Delhi, on 'Conservation Studies & Problems in Developing Countries with special reference to India' was presented by Shri A. Lal, Deputy Librarian, National Library, Calcutta in his absence.

The paper dealt in detail with the state of library conservation in developing countries particularly with the problems of libraries in tropical zone. The paper discussed the storage problems, higher rate of aging of paper and insect and fungus infestation incidence. While dealing with the various processes adopted in conservation of library materials, he also pointed out the techniques, local and indegenous which have been found useful. He advocated these techniques for the libraries of developing countries in view of the higher cost of sophisticated methods which are beyond their resources. Initiating the discussion Shri A. C. Das, Assistant Librarian, the National Library on this paper said that new methods of deacidification with Diethyl Zinc for mass deacidification was still under experimental stage.

Dr. D. K. Mittra, Assistant Librarian, National Library, Calcutta presented his paper on "Conservation of Maps in the National Library, Calcutta." He discussed the physical nature of the map collection and methods of storage adopted in the National Library. He also referred to the maps received from various agencies including Government agencies and observed that they were on poor quality paper and as such required deacidification and restoration. He also pointed out that the Nepalese handmade paper and nylon net proved very useful in mounting the maps.

Shri Sunil Chatterjee, Librarian, Carey Library, Serampore raised a problem of restoration of maps bound as an integral part of a brittle book. Shri A. C. Das, Assistant Librarian, the National Library suggested that in such case either format of the entire book should be brought to the size of the largest map after deacidification and repairs or the maps should be disected into suitable sections and mounted and folded to the size of the book and bound alongwith it.

Summing up the discussions Dr. Mahapatra, Chairman, the first technical session, said that all the papers presented in this session dealt with paper : Print on paper, map on paper, painting on paper, etc. He welcomed the concern that deterioration of paper was due to the poor quality and delegates emphasised better quality of paper to ensure better preservation.

The first technical session concluded with vote of thanks.

Group photograph of the delegates was taken in the afternoon.

Session Three (Technical) on 22-1-85.

Chairman :

Shri B. B. Chaudhuri, former Deputy Librarian, the National Library, Calcutta.

The paper of Shri Y. P. Kathapalia for Asstt. Director, National Archives or India, New Delhi (an UNESCO expert in Conservation of paper based material) on Conservation and Repair of Paper Based Material was read by Shri A. Lal in his absence. The paper dealt in detail with all the aspects of paper including the nature of older paper and the qualities of the modern paper. While discussing the acid as the potential cause of the paper decay he discussed seven different methods for deacidification of paper documents. He also dealt with the damage caused due to water specially in floods and the process of recovery and restoration. While dealing with the restoration the author discussed the latest restoration techniques and materials.

The paper generated interest among the participant conservators. Shri Sudhir Das discussed about the lamination with polythene film with the reversibility aspect. Kathapalia's solvent process of lamination with acetate film was widely appreciated as the process did not require costly machines etc.

Biodeterioration due to insects and fungus is a very common problem of the libraries. The paper of Dr. S. M. Nair, Director, Natural History Museum, New Delhi, was presented by Shri N. N. Sarkar in his absence. The paper discussed the common fungi which attack the library collections and their effect. Besides fungi, the common insects of the library were also dealt in detail, with their habitate, nature and mode of damage to the library stock, repairing and binding materials and general hygiene of the library.

Discussion which followed the paper was indicative of the keen interest of the librarian and the conservationist in this respect. Shri Sudhir Das, while further elaborating the points, mentioned, that damages due to water, if not taken care of immediately, create fungus epidemic in the library. He also pointed out stagnant air of the stacks gives ideal environment for fungus growth. To a question from Shri Prabir Roychoudhury on fungus control, Shri Sudhir Das, explained that air circulation is one of the prerequisites for this purpose.

Shri N. N. Sarkar, Chemist, the National Library, Calcutta gave a graphic description for control of insects. He advised that since air-conditioning is still a far cry for most of the libraries, cleaning is the best deterent for insect growth. He advised regular disinfection which can check the growth to some extent. Mr. Sarkar in his reply to Shri Sudhir Das, explained the greater efficiency of vaccum fumigation. He discussed in detail the effect of varying quantity of the ethylene oxide and carbon dioxide mixture (1 : 9) on insect control.

He contended that the vacuum fumigation with the above insecticide should also be effective against fungus. But he warned that the results for fungus were not 100%. Some spores although extremely negligible get immuned and germinate after a long period of liberation. Some of the questions were raised on the control of rats. Dr. S. Mukherjee of Indian Museum, expressed that rats mostly made entry into the stacks for food left over by persons who bring it into the stacks. When this food was not sufficient for the rats they attack anything and every thing of the stacks. He therefore, suggested that besides the use of rodenticides no food stuff should be allowed inside the stacks area.

Mr. Munna Swami, Director, State Archives, Bangalore and Mr. K. V. Seth of L. D. Institute, Ahmedabad expressed the deep concern for the termite attacks inside the stacks. Shri A. Lal, Dy. Librarian, the National Library explained that termites are one of the most difficult insects to control. They cannot be eradicated easily as this sources is often 1 km. away from the spot of incidence. He suggested that all new constructions should be got termite proof from the very foundation and old buildings should get the preventive treatment done. Control of termite, is more technical and requires judicious use of insecticides to avoid hazards and therefore should be entrusted to expert agencies.

The paper on conservation of Palm leaf, etc. by Shri C. B. Gupta, Senior Restorer, National Museum, New Delhi, was presented by Shri Sudhir Kumar Das, Preservation Officer, Asiatic Society, Calcutta.

This paper dealt in details with the various writing materials used including vellum, parchment, palm leaf, paper, etc.

Palm leaf specially attracted the interest of participant conservators. To a question raised by Shri S. P. Banerjee, Assistant Librarian for Rare Books, the National Library, Calcutta, Shri Das described in detail the various types of palm leaves and their characteristics, made of use, storage, repairs and preservation besides writing.

The paper on 'Conservation momement in India' by Shri O. P. Agrawal, Head, National Research Laboratory for Conservation of Cultural Property, Lucknow, was read by Shri A. K. Ghosh of Victoria Memorial, Calcutta. This paper highlighted the awakening of the concept of Conservation in the country and also pointed out the present optimistic atmosphere in strengthening the conservation activities. It also stated that the establishment of INTACH (under the Chairmanship of the Prime Minister, Shri Rajiv Gandhi) is a very effective stage in the conservation movement of the cultural property in India and hoped that the public opinion would rise to the occasion to save the past. This paper also dealt with the conservation work being done by different Government oraganisations in the country.

Discussion on the paper followed, Shri A. Lal, Dy. Librarian, National Library reminded the participants that Calcutta holds a special responsibility in the field of conservation. It is in Calcutta, first that the conservation was started in 1920 by the Archeological Survey of India by appointing Shri Sanaullaha as conservationist after his training at British Museum in London. He also pointed out that in 1920, Chapman, the then

Librarian of the Imperial Library was first a concentious conservator and then a librarian who felt aggrieved with the poor quality of paper and fast decay of the books in the Imperial Library at Calcutta, as compared to books at higher altitude and in temperate zone. Shri A. Lal also referred to the opening speech of the Director Shri Ashin Das Gupta, where he had stated that this seminar was the first of its kind in the country on conservation of the library materials and held again in Calcutta.

The paper on "Creation & Conservation of Photographic Records" by Shri V. V. Talwar, Assistant Director, National Archives, New Delhi was read by Shri V. Kotnala, Microphotographer, the National Library in his absence.

The paper gave an exposure to the role of micrographics in conservation of library materials with emphasis on the requirements in terms of equipments, production, retrieval and storage of microforms. The discussion generated by the paper indicated the keen interest among the participants and a general awareness to the application of micrographics in the library field. Clarifications regarding longivity of microfilms for archival storage with or without air-conditioning, etc. were made and ideal storage conditions of the microfilms were discussed. Among the notable participants in the discussions were Dr. P. B. Barua, Director of RRRLF, Dr. P. K. Mahapatra, Reader, Department of Library Science, Calcutta University, Shri A. B. Roy, Assistant Librarian, National Library, Shri Muna Swami, Director, State Archives, Bangalore, K. V. Seth from L. D. Institute of Indology, Ahmedabad and Prof. Santosh Bose, Head of the Department of Museology, Calcutta University.

Summing up the third technical session Chairman Shri B. B. Chaudhuri emphasized the need for alertness on the part of the librarians and conservators for the safety of their collection. He also emphasized the need of standardizing these techniques and materials for better conservation. Giving instances of his personal experience in conservation, Shri Choudhuri emphasized that it was not always a foreign technology which could help us out of the problems, but there were many indigenous methods and materials which were equally good. He emphasized the need of investigation in these fields also.

Concluding Session :

Chairman, Shri P. B. Roy discussed the problems raised by the participants. There was a very strong feeling for proper training of personnels in conservation.

Shri P. B. Roy as Chairman summed up the discussion of the entire seminar and expressed the need of more such seminars where the librarians, conservationists, museologists and chemists take part in joint discussions.

He felt that the National Library, Calcutta had given a start to this and hoped that they would be more frequent and would also take place in different parts of the country so that more persons would be benefitted.

The reporters then drew resolutions on the basis of the discussions. It was also decided that the technical papers, select reading list on conservation of library materials, proceedings and recommendations should be sent to the Government and other relevant authorities and persual for implementation. All these papers should also be got printed.

Smt. Kalpana Dasgupta, Librarian, the National Library, Calcutta extended a vote of thanks to the participants.

The Seminar closed with thanks to the Chair.

17. RECOMMENDATIONS OF THE SEMINAR ON CONSERVATION OF LIBRARY MATERIALS HELD AT THE NATIONAL LIBRARY, CALCUTTA ON THE 21ST & 22ND JANUARY, 1985

Realising that enormous documentary wealth of the country stored in different libraries and information centres of India are exposed to various kinds of hazards for want of adequate measures of conservation and that there is a need for a massive programme to protect those reading materials, manuscripts, books and other documents containing the cultural heritage of the country;

Understanding the utter lack of facilities for any comprehensive programme on a national scale for conservation measures in libraries and information centres, museums and archival institutions in India;

Surveying the meagre conservation facilities that are now available in the country;

This seminar on 'Conservation of Library Materials' held at the National Library, Calcutta, during January 21-22, 1985 wishes to make the following recommendations :

Creation of general awareness :

(i) that the Ministry of Culture, Government of India may make adequate funds available to the National Library to enable it to organise mobile exhibitions to impress upon the public in general and also the librarians and library workers in different categories of libraries, the need for and the methods of conservation work relating to books as well as other documents particularly stressing upon some vital aspects of conservation work and problem of the country;

(ii) that the National Library may for this purpose seek the co-operation and utilise the expertise of the conservation divisions of some leading libraries, museums, Departments of Museology, National Council of Science Museums, and the like in order to prepare a detailed plan for organising the exhibition and for executing the programme as much thoroughly as possible;

Framing of general guidelines provision of appropriate accommodation, equipment and personnel for setting up of conservation units :

(iii) that the National Library may also play a leadership role in seeking co-operation of conservationists working in libraries, archives, museums and research institutes, to frame general guidelines for setting up of conservation units with special reference to the standard requirement of space, equipment, and personnel keeping in view the quantity as well as the nature and complexity of work that the unit will have to undertake;

Extension of technical facilities :

(iv) that in view of the extremely meagre conservation facilities available in the country in general and the Eastern Region in particular the Conservation Division of the National Library may be suitably expanded to enable it to provide conservation assistance to various types of important institutions located in the Eastern Region.

(v) that in order to make conservation facilities more easily and quickly available to institutions situated in different regions, Regional Laboratories for Conservation may be established in different regions of the country in the pattern of one *viz.* National Research Laboratory for Conservation of Cultural Property, already in existence in Lucknow ;

Education in conservation theory and methods :

(vi) that in order to make uptodate knowledge in conservation theory and methods available to the country for application, the Government of India should declare a national policy for education in conservation of documentary and other allied resources and see that the policy is duly implemented to attain the desired objectives ;

(vii) that Departments of Library and Information Science and of Museology and professional bodies engaged in teaching of the subjects and in issuing degrees/certificates of competence for professional appointments should incorporate practical conservation work and laboratory assignments along with theoretical training as integral parts of their teaching and training schemes ;

(viii) that scope for introducing full-scale specialisation in conservation work at a Master's Degree level be immediately explored in Post-Graduate Centres of Library and Information Science and Museology ;

(ix) that the University Grants Commission, the Ministry of Education, Government of India and the Departments of Education of the different States of India be approached for providing suitable financial grants for encouraging research work in conservation theory and practice at doctoral level in Post-Graduate Departments of Library and Information Science and Museology who will work in close co-operation with leading libraries, museums, archival institutions and research institutions devoted to conservation ;

(x) that the institutions of higher learning may for such purposes utilise the services of senior scientists and technical personnel working in reputable conservation units for teaching as well as for guiding researches leading to doctoral degree where found suitable ;

(xi) that all positive steps should be taken to pool the expertise and technical competence of teachers, scientists and technicians engaged in conservation of manuscripts, books, documents and related materials in libraries, museums, archives and centres of higher studies by organising seminars, inter-change of technical personnel between different institutions and by providing specific teaching assignments backed by suitable supporting financial grants from concerned authorities.

Informal education programme :

(xii) that the Indian Language Divisions of the National Library, the Bharatiya Bhasha Parishad and other similar authorities be approached with the request that they may work together to compile a vocabulary in the major regional languages of an adequate number of expressive technical terms used in the field of conservation and allied work so that writing of technical books and articles in the vernacular languages for use of conservation workers at the grass root level become feasible ;

(xiii) that the National Library may take the leadership in trying to persuade the Departments/Directorates responsible for organisation and development of libraries and museums of the States to organise popular workshop education camps, seminars and exhibitions at district/block levels for imparting of some quick basic training to the members of the staff who are allotted conservation and restoration duties in the libraries and museums of the state ;

Survey of traditional methods of conservation :

(xiv) that the National Library may seek co-operation of the National Archives, Museums of national importance, the Indian Institute for the Conservation of Cultural Property and other similar expert bodies, to collect and evaluate information on the traditional methods of preservation of reading and allied materials for the purpose of utilising such age-old and historically validated methods to the extent that they are found to be suitable on scientific consideration ;

Provision of finance :

(xv) that the authorities concerned with provision of funds for management and development of libraries and museums of different categories be requested to make earmarked allocation in the respective budgets for developing uptodate conservation units wherever feasible and/or for adoption of suitable programmes for conservation and preservation work for preservation of all documents considered worthy of preservation ;

Availability of materials and equipments :

(xvi) that in view of the paucity of information regarding local availability of different ingredients like chemicals, tissuepaper, herbal products and different types of equipment needed for conservation and restoration works special efforts may be made for compilation of a handy directory giving information about manufacturers, stockists and traders of the needed materials as well as the trade names and scientific names of the articles concerned ;

(xvii) that the Government of India may be approached to ask some centralised agency or public sector undertaking to examine the viability of manufacture of different kinds of conservation materials and of importing those materials which are not at present available in the country ;

(xviii) that the Hindusthan Paper Corporation, a Government of India Undertaking working in the field of paper, be requested to look into the feasibility of manufacturing some quantity of acid free paper which may be needed by publishers for publication of very costly and very important publications worth preserving for social reasons for very long time ;

Publication of select copy in good quality paper :

(xix) that the publishers' and booksellers' associations may be requested to realise the national importance of preservation of books and other allied materials and agree to publish a few copies of their non-ephemeral publications on specially good quality of paper which may be earmarked for depositing under the Delivery of Books & Newspapers Act, 1954 and Press & Registration of Books Act, 1867 and sale to important libraries who may have need for preserving such documents for study and research ;

Pay and Status of technical personnel engaged in conservation work :

(xx) that Chemists, Conservators and other technical personnel engaged in idependent conservation work be given status of full scale officers of libraries, museums and archives with appropriate designations, status, pay scales and other financial benefits commensurate with their responsibilities and necessary posts may be created for senior technical personnel with full administrative implications.

(xxi) that the Binders, Menders, Gold tooling hands and other similar persons doing technical work in the conservation unit under extremely depressing pay scales and service conditions may be put into proper grades befitting the specialised and technical work that they have been performing so long.

This Seminar requests the organisers to examine the feasibility of bringing a special publication which may contain the papers presented, proceedings of the Seminar along with the recommendations made by it.

18. CONSERVATION OF LIBRARY MATERIALS
A SELECT BIBLIOGRAPHY

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184. ISI SPECIFICATIONS

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Indian standard code of practice for storage and use of microfilms of permanent value. New Delhi, the Institution, 1965. 8 p. IS : 3130-1965. Rev. ed. 1972.

Indian Standards Institution. New Delhi

Indian standard code of practice for the processing of microfilms (silver halide). New Delhi, the Institution, 1966. 6 p. IS : 3083-1966.

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Indian Standards Institution, New Delhi

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Indian Standards Institution, New Delhi

Indian standard specification for method for the determination of residual thiosulphate and tetrathionate in processed photographic paper. New Delhi, the Institution, 1972. 6 p. IS : 6650-1972.

Indian Standards Institution. New Delhi

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Indian standard specification for wrapping tissue paper. New Delhi, the Institution, 1977. IS : 8460-1977.

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Indian Standards Institution, New Delhi

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G. P. 667.5 In 2

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   1, Park Street
   Calcutta-Calcutta-700 016
9. Khuda Bux Oriental Public Library
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10. Salarjung Museum
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